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PUBLIC HEALTH ADMINISTRATION AND THE NATURAL HISTORY OF DISEASE IN BALTIMORE, MARYLAND 1797–1920

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BY

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PREFACE.

In this work the author has attempted to portray the development of the laws and practices of public-health administration in Baltimore, to trace the ideas underlying their origin and gradual evolution, to inquire into the natural history of those diseases which may be followed in the records of the Health Department, and, finally, to correlate as closely as possible all the ascertainable factors that may have influenced their courses. For the latter purpose, it has been necessary to present in some detail the essential facts concerning the location, origin, and growth of the city, the medical profession, the hospitals and other public agencies, the dwellings, and the growth and racial composition of the population.

The foundations of this study were laid for very practical reasons, during the author's service as assistant commissioner of health for the four years ending in the autumn of 1919. The first two years of the period were crowded with the details of administration, which necessitated intimate acquaintance with the history, the personnel, and the activities of each and every bureau and division of the health department. During the last two years, through the broadmindedness and interest of Mayor James H. Preston, who readily appreciated the importance of accurate study, by epidemiological and statistical methods, of the natural history of the diseases the city was undertaking to combat, provision was made for relief from administrative detail.

Beginning with typhoid fever and tuberculosis, systematic studies were made of the common communicable diseases, in turn, by mortality since 1827 and by morbidity since 1898. Studies of poliomyelitis, tuberculosis, typhoid fever, influenza, infant mortality, accidents, and of the influence of race stock upon mortality of various diseases were published in the annual reports for 1916, 1917, and 1918.

These studies were directed primarily to three main objectives, namely, the elucidation of the actual problems of disease control, critical appraisal of the efficacy of the methods in use, and modification and further development of methods in the light of knowledge that might be gained. Investigation soon disclosed truths which lead to conclusions at variance with many accepted doctrines and practices of public-health administration. It soon became evident that in many respects the game is far more cunning than its would-be trappers, and that the problems of control and extinction of many of the communicable diseases are concerned with great and fundamental problems of general biology far transcending present knowledge and the solution of which lies beyond the scope of present-day health officials and sanitarians in general. Some of the advice offered as the result of these studies was accepted, but much was rejected as too unorthodox.

It was Professor Raymond Pearl who first appreciated the real value of the data thus collected and who suggested that the scope of the investigation be expanded and the results published in book form. To this end, among others, his invitation in the autumn of 1919 to join his staff was heartily welcomed. In November of that year the statistical and historical data, with many of the

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CHAPTER I.

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LOCATION AND TOPOGRAPHY.

Baltimore, the chief city of the State of Maryland and of the southern Atlantic seaboard, is situated in latitude 39° 17′ N. and longitude 76° 37′ W., on the Patapsco River and the Middle and Northwest Branches, at the point where these join to form a broad and deep estuary leading directly to the Chesapeake Bay some 12 miles distant. At the head of tidewater, 172 miles from the Atlantic Ocean, from which it is approached over a great and easily navigable inland sea, with safe and ample harbor and convenient piers and with good communications with a territory rich in natural and developed resources, it occupies an important strategic position as a port of entry, exit, and distribution for domestic and foreign trade. Its past, present, and future are intimately bound up with these circumstances.

A second attribute of deep significance dependent upon physical geographical characters is the city's situation on the fall line, at the junction of the alluvial and Piedmont soils, or where the water-laid coastal and the granitic formations meet. Indeed, the city straddles these, its lower portion, or water front, being on the former, and its larger and higher sections resting on the latter. Away from the water front the soil consists of clay and sand hills covered in many places with a thick coat of gravel. This series of hills, rising from 10 to nearly 200 feet above tide, has in the main a northeast and southwest direction. Between them course in a general northerly and southerly direction five streams. Two, Harford Run and Jones Falls, running through deep and somewhat irregular valleys and carrying considerable volumes of water, empty into the Northwestern Branch or Basin; the other three, Rutter's Run and Schroeder's Run, both comparatively small, and the larger Gwynn's Falls discharge into the Middle Branch.

Gwynn's Falls is near the extreme western boundary and Jones Falls bisects the city into two nearly equal parts, the eastern and the western sides. In earlier days, before the city was built up, a number of smaller brooks fed from springs, and coursing through narrow valleys between the hills, discharged, either directly or indirectly by means of the above-mentioned streams, into the basin or into the Middle Branch. These and other topographical features yet to be described may be followed on maps 1 and 2.

At different periods in the city's history all these streams, with the exception of Gwynn's Falls, have been covered over. Originally the valley of Jones Falls,

[1] Figures in parenthesis refer to bibliography at end of this volume.

the most important stream, rose rather sharply to the hills on its west side, but spread out widely with a comparatively flat surface for some distance on its eastern side. No high hills separated the valley of Harford Run from that of Jones Falls; indeed, it appears that these two streams shared the same valley over much of their courses through the site of Baltimore. At a comparatively short distance from the water-front, the east side of the valley of Harford Run rose somewhat gradually to meet a series of high hills. The consequence is that with the grading that accompanied the development of the city, the descent to this combined valley, over a certain large area, is abrupt on the west and gradual on the east side. The formation above described in the higher portions of the city is well adapted to surface drainage, both from north to south and from east to west. All of these streams, and Jones Falls in particular, were frequently subject to overflow after very heavy rains, and as the city grew it became necessary to wall their banks and in some instances to straighten their courses. In earlier days these streams were of great importance on other accounts; both Gwynn's and Jones Falls were used to turn mills, the latter being for a long time an important source of water-supply. All of them have served continuously as storm-water sewers and until recent years, in varying degree, as sanitary sewers as well.

Turning now to the water-front, the land between the basin and the first range of hills to the north was comparatively low, but sloping in a general way from north to south. Near the mouths of the streams, along the shores of the basin and on those of the Middle Branch (Spring Gardens), there were wide marshes, which for many years were sources of nuisance. Between the western side of the basin and the Patapsco River there projects a long tongue of land, Whetstone Point, marked at its base by a towering hill (Federal Hill) and along its center from base to tip by a ridge from each side of which the surface inclines to the water. At its southern extremity is situated the famous Fort McHenry. This comparatively narrow strip of land forms the southwestern boundary of the old harbor, and from early days its eastern side has been the seat of important docks and terminals, as well as shipbuilding and other kindred activities. Opposite a point of land (Locust Point) which projects from about the center of the northern shore of Whetstone Point, lies Fell's Point, the eastern boundary of the basin. The ground here was uneven and in general low. To the west and at the base of this point empties Harford Run. In early times, before the basin was dredged for this purpose, Fell's Point was the head of deep water and the docking-place for vessels of deep draft. Somewhat to the east of the center of the northern shore of the basin, Jones Falls discharges. To the west of its mouth were the docks and piers for vessels of lighter draft. Directly opposite Fort McHenry and over 2 miles southeast of Fell's Point is Lazaretto Point, long the seat of the quarantine station and of the old lazaretto for the reception of goods from quarantined vessels.

To the east and west of the city, along the fall line, extends a narrow and comparatively low ridge containing iron ore, wherefrom the ridge derived its name, Mine Banks. To the south of the Mine Banks and on each side of the Patapsco River the land is in general relatively flat, with numerous inlets and small streams and was formerly marked by swamps and ponds. From the earliest records until recent years this region was a hotbed of malaria, and in it the city's quarantine hospitals and pest houses have always been situated.

SETTLEMENT AND GROWTH IN AREA.

In 1729, on petition of the inhabitants of Baltimore County, the General Assembly of Maryland provided for the erection of a town upon the Patapsco River. In consequence, in September 1730, 60 acres of land, situated just north of Northwestern Branch of the Patapsco River, purchased of Charles and Daniel Carroll, was divided by commissioners into 60 lots of nearly equal size, with the necessary streets, lanes, and alleys, and named Baltimore Town. It will be noted from map 1 that the original town was irregular in outline. The basin, since considerably narrowed at this point by fillings, formed part of its southern boundary. On the north side the town was limited by the first considerable range of hills. To the east were the marshy lowlands bordering the mouth of Jones Falls. Only one street led to the water and the primitive docks. Through the center of the town from east to west ran the principal thoroughfare, known as Market Street, which was in reality the road connecting Philadelphia with the southern colonies. The avowed reason for establishing this town was the necessity for an additional port to serve the surrounding territory, which was fast becoming an important farming country. Until 1780 the port of Baltimore Town was subsidiary to Annapolis.

In 1732, also pursuant to act of the General Assembly, Jones Town (see map 1) was erected on the east side of Jones Falls and northeast of Baltimore Town. It consisted of 20 lots of approximately one-half acre each. Jones Town was united with Baltimore Town in 1745. As these original settlements grew, more land was incorporated, drained, and built upon on both sides of Jones Falls to the basin.

As early as 1730, William Fell, a shipwright, had settled on the point bearing his name. With the expansion of commerce and shipbuilding, the region about Fell's Point was rapidly built up, and in 1781 it, too, was legally joined to Baltimore Town.

By act of the Legislature, Baltimore Town became Baltimore City on December 31, 1796. It will be observed on map 1 that by 1801, when the population numbered about 27,000, extensive changes in the physical characters of the situation has been made. Jones Falls in its lower part had been canalized with masonry walls and the marshes on each side of it and about the north and west sides of the basin filled in and built upon. Extensive docks lined the north and west sides of the basin and Fell's Point. The main streets, with few exceptions, ran directly north and south and east and west, and were laid out with great regularity. This same regularity, with ample width for most streets, imposed by the early surveyors, has persisted throughout the city's history. The tendency to cling to the water-front and to expand easterly and westerly rather than to the north was a striking feature of the town and early city. This has been overcome slowly under the influence of railroads and modern rapid transit.

In 1816, by annexation of territory to the east, west, and north, the corporate limits were considerably increased. The city now included 13.2 square miles. These limits remained fixed until the annexation of 1888, when 18.45 square miles were added. By the annexation of 1919, the city lines were again considerably extended. With this the corporate limits embraced 91.93 square miles. With each annexation there was included a fringe of closely built-up areas, im-

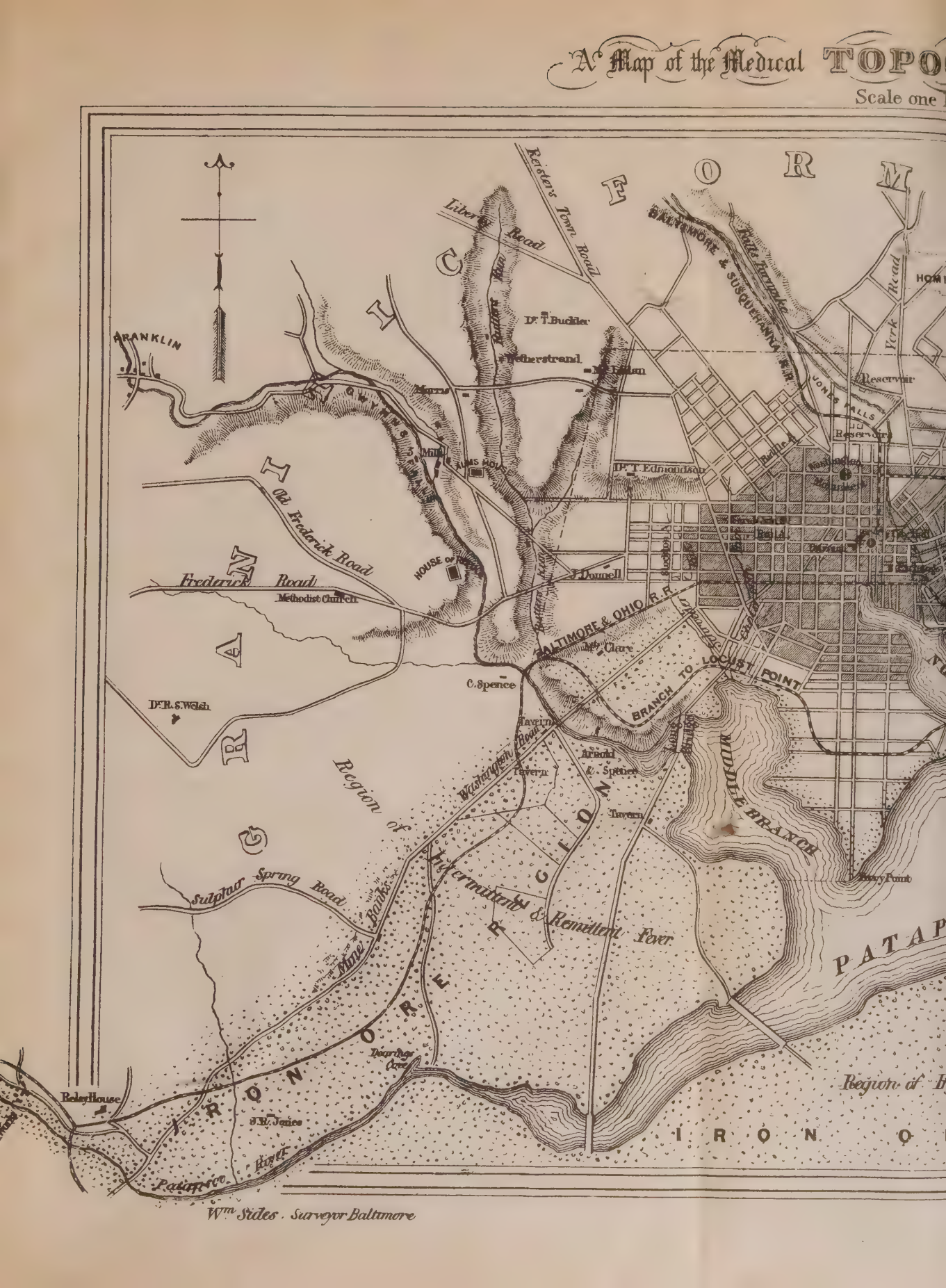
mediately contiguous to the old city lines, and extensive outlying areas of village and rural territory, all containing manufacturing and other industries, chiefly located along the streams and the harbor.

FACTORS DETERMINING THE EXPANSION IN WEALTH AND COMMERCIAL IMPORTANCE.

The birth, growth, wealth, and civic history of Baltimore are intimately correlated with water-borne trade. In the minds of the petitioners for the erection of Baltimore Town, the harbor for the convenient loading of tobacco, then the principal staple of export and medium of exchange for manufactured goods needed, was the chief consideration. The first public building was a tobacco warehouse situated near the basin. A second factor of prime importance was its situation on the Philadelphia Road, the direct land route between New England, New York, and Philadelphia and the rich southern colonies. To the land side, striking natural advantages were convenient deposits of copper and iron ore within easy reach, abundant timber of great variety and of fine quality from nearby forests, the water-power of Jones and Gwynn's Falls and of the Patapsco River and other streams, fine clay for brickmaking within her gates, marble and other building stone at her doors, and the rich agricultural lands of first the Piedmont and later of the Ohio Valley for grains, flax, meats, hides, vegetables and similar products. Tobacco from the tide-water counties, and fish from the Chesapeake Bay could be readily shipped in vessels.

These great natural advantages were cultivated and later exploited by a rapidly growing band of adventurers drawn first from Maryland, then from the British Isles, and particularly from the north of Ireland and Scotland, and later from Virginia, North Carolina, New England, New York, and Pennsylvania. Of considerable importance were two groups of French extraction, the Acadians who were forcibly transplanted by the British in 1756 and the San Domingan refugees who arrived in 1793. The arrival, after the middle of the eighteenth century, of a few people of German extraction, largely from Pennsylvania, who were trained in the arts of spinning and weaving and in saddle and harness making, was opportune.

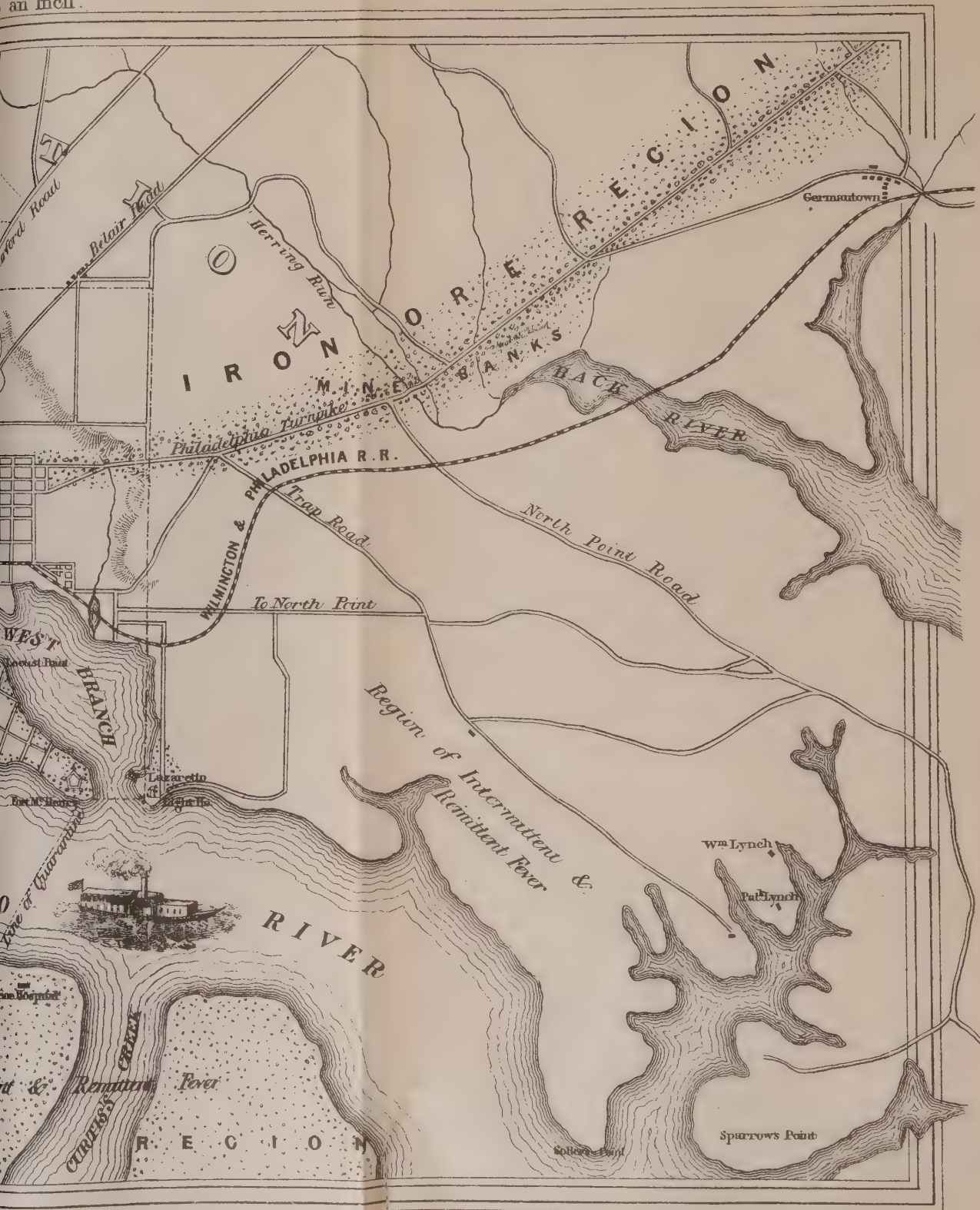
Despite the natural advantages and the adventurous and determined population, the early growth and progress of Baltimore would not have been possible without another gift—a genius for innovation and adaptation in transportation on both water and land. The genius of Baltimore shipbuilders developed the famous Baltimore clipper, the fastest cargo and fighting wind-driven vessel known to history. On the same model they built, first the small schooner and later the larger square-rigged vessel, the bark, the brig, and their modifications, and the full-rigged ship. These two types differed only in size and rig, and their startling success was due to two characteristics—the design of the hull and the tall masts carrying an unusual area of sail. This model, "full forward and off aft" or "catfish head and mackerel tail," was broader and higher in the bows than in the stern, and further characterized by "a great dead-rise at her mid-ship section, long, easy, convex water-lines, low free-board and raking stern, stern-post, and masts." This design, variously ascribed to the Chesapeake water-fowl, to Capt. John Smith's pinnace, and to the French lugger, specimens of which visited the Chesapeake during the Revolution, marked a great


A Map of the Medical TOPO
Scale one
BALTIMORE
CAROLINE
Reister's Town Road
Liberty Road
Patapsco Ferry Road
Baltimore & Susquehanna R.R.
York Road
Reservoir
Jones Falls
Franklin
Old Frederick Road
Frederick Road
Methodist Church
Dr. T. Buckler
Dr. T. Edmondson
J. Donnell
Baltimore & Ohio R.R.
Branch to Locust Point
Middle Branch
C. Spence
Dr. R. S. Welsh
Tavern
Arnold & Spence
Washington Road
Region of Intermittent & Remittent Fever
Sulphur Spring Road
Mine Banks
Deer Creek
Rigle
Patapsco
Riley House
S. E. Jones
Wm Sides. Surveyor Baltimore

APHY of Baltimore, 1851.

an Inch.

MAP 2.



(From Dr. Th. H. Buckler.)

advance over the ungainly hulks of the British navy and merchant marine. Owing to the superiority of model, excess of sail, and the unusual skill and daring of their skippers and crews, these vessels outsailed and outmanœuvred everything afloat and laughed at blockading fleets in both home and foreign waters. As privateers they were particularly well adapted, and great wealth was brought to Baltimore in prizes and prize-money during the wars with Britain. During the wars of the French Revolution and of Napoleon, the enterprising Baltimore merchants captured with these vessels a large part of the world's shipping trade. They were especially active in the West Indian, South American, Mediterranean, Spanish, North Sea, and Baltic ports. Some reached out to the Orient. The clipper-ship era lasted until the opening of the Suez Canal in 1869. This ship, which sacrificed cargo capacity to speed, was especially serviceable in time of war, for perishable and manufactured goods of small bulk and for passengers. It finally gave way to the coasting schooner and the steamship, and had almost disappeared by 1890. One of the most famous, the *John Gilpin,* on a voyage to the Orient and to South America, sailed some 34,920 miles at the average rate of 183 miles a day.

With the settlement and development of the country in her rear, first nearby in Maryland, and then at a distance to and over the Alleghenies, land transportation became a matter of great importance to the growing city and its tributary country. For a time, rough wagon-roads and pack-trails sufficed. Late in the eighteenth and early in the nineteenth centuries the construction of wide turnpikes to strategic centers was begun. Thus, the Harford, York, Reistertown, Frederick, Washington, Philadelphia, and other roads were gradually converted into broad highways, with solid foundations and coverings, capable of supporting the huge "Conestoga" wagons, carrying from 6,000 to 10,000 pounds and drawn by teams of 6 to 8 horses or mules.

Of great significance in this connection was the opening in 1818 of the National Pike from Cumberland, Maryland, running over the mountains to the Ohio River. This national thoroughfare was later extended to Indiana, Illinois, and Missouri, and, until the passage of the railroads beyond the Allegheny Mountains in 1852, was the highway from East to West for the mails and most of the travel and traffic. The improved State highway from Baltimore to Cumberland was completed in time for Baltimore to take full advantage of the National Pike to hold and to extend her trade with the West, for which she was the natural market. As early as 1819 a stage route was established to Pittsburgh and Wheeling.

By 1823, however, her supremacy was threatened on the one hand by Philadelphia, over the highways built through Pennsylvania, and on the other by New York, over the newly opened Erie Canal. Somewhat later, steamers from New Orleans invaded the Ohio River. But Baltimore merchants arose to the occasion and planned and executed their second great contribution to transportation, this time by land. Casting aside the first considered plan, canals from the Susquehanna and the Potomac rivers, they decided to construct a railroad from Baltimore by the most direct route to some point on the Ohio River. This decision, arrived at in 1827, resulted in the Baltimore and Ohio Railroad, the first railroad for general purposes. Most of the early problems of track and motive power were solved by Baltimoreans. The new road was open to Point of Rocks, 72 miles, in 1832, to Harpers Ferry in 1834, to Cumberland

in 1842, and to Wheeling in 1852. Connection with other roads opened the Baltimore and Ohio service to Cincinnati and St. Louis in 1857. Meanwhile, at Harper's Ferry, connections were made with short but important railroads leading into the Valley of Virginia. The extension to Cumberland made available extensive fields of cheap steam coal to Baltimore.

Other railroads soon followed. The Baltimore and Susquehanna, begun in 1829, the Philadelphia, Wilmington and Baltimore and the Baltimore and Potomac started about 1830, financed partly at least by Baltimore, and finally absorbed into the Pennsylvania Railroad system, connected Baltimore by rail with Philadelphia and New York, Pittsburgh and the South. The Western Maryland, running more centrally through the State than the others, was inaugurated in 1852.

By 1880, with the extension and consolidation of trunk lines throughout the country, which connect with all the great Atlantic seaports, Baltimore had lost all of her relative advantages except one—her position nearer to the West and South gave shorter hauls and thereby a favorable differential in freight rates. This, with highly convenient terminal facilities, and Chesapeake, coastwise, and foreign steamship lines, has helped to preserve her importance as a port. Advantageous arrangements made early between the Baltimore and Ohio Railroad and the North German Lloyd Steamship Company fostered a large trade through Bremen. Of late years cargo steamship lines have been widely established, but particularly with British ports.

It is not possible to follow here in detail all the shipping, manufacturing, and jobbing activities of Baltimore. It was natural that in the port of export and import of a rapidly growing and developing territory, wholesale jobbing should become and remain an important industry, and that in connection with this as well as with materials near at hand or readily obtainable, an enterprising population should develop the manufacture of iron, copper, chrome, and grain products; tobacco; wooden, clay, and leather ware; powder; cotton and woolen goods; clothing, hats, shoes; and the like. Nor is it strange that in such a community banking should have been highly developed at an early date, and that investments in transportation and manufacturing enterprises in the West and South have made high returns.

Certain very distinct periods of growth and depression characterize Baltimore's history. Until 1776 growth was comparatively slow. The Revolution, in which she played a conspicuous part by both land and sea, found Baltimore a struggling shipping village and left her an embryo city of fearless and bold, yet hard-headed, inhabitants, with ships, shipyards, foundries, mills, and unrivaled harbor, and with a rich and expanding farming community in the rear. Freed from the shackles of British navigation and manufacturing laws, within the next 30 years her growth in population and wealth was fabulous. Between 1790 and 1810 the population increased nearly 250 per cent. Her merchants were rich, her professional men in medicine, law, and theology were distinguished, her general population was prosperous, well housed, and fed, and all classes were contented. With food in great variety and abundance and of the best quality, to be had cheap at convenient markets, with famous beers and whiskies made locally, and every facility for the importation of foreign liquors, material conditions were very attractive. Life was characterized by an easy and genial courtesy and hospitality.

During the embargoes of the years just preceding 1812 and the period of this war, when the Chesapeake was occupied by the British fleet, but especially as the result of the succeeding general financial collapse and the consequent decline in commerce and industry, Baltimore suffered severely. It is recorded that in 1819, 20,000 people were out of employment. From 1825 to the outbreak of the Civil War in 1861, Baltimore prospered in the main. During this period crowds of immigrants, mainly from Ireland and Germany, entered at the port, and many settled in the city.

The city was hard hit by the Civil War, for coastwise and foreign trade was restricted, southern trade was interdicted, and trade with the West was paralyzed. During much of this period the city was under military rule and occupied by Federal troops, against whom a large and influential portion of the population was hostile. Recovery was slow and not until after 1880 was the corner turned. Since 1890 great advances have been made in trade and in wealth from many sources. A great fire in 1904 destroyed a large portion of the business section. In connection with reconstruction, which was soon completed, extensive improvements to the docks and piers of the basin were carried out.

FORMS OF GOVERNMENT.

Baltimore Town was governed by commissioners, sometimes appointed by State authority and sometimes elected on a restricted franchise. With few exceptions, the laws under which the town was governed were passed by the Colonial Assembly or by the Legislature of the State. Granted a charter in 1796, Baltimore was incorporated as a city January 1, 1797, under the title of the Mayor and City Council of Baltimore City. Since this date, but with several more liberal charters granted at various times, the government has been carried on by a mayor, a bicameral city council, a judiciary, and a local magistracy. For civic purposes, the political subdivisions are wards. For nearly half a century the control of the police force has been in the hands of commissioners appointed by the governor of the State. Since the charter of 1900, the responsibility of the city government has been concentrated in the hands of the mayor and the board of estimates, consisting of the mayor and the heads of departments, who are, with several important exceptions, appointed by the mayor, and subject to confirmation by the council. The schools, the park system, the jail, the harbor, the city charities, and the sinking fund are conducted by special boards composed of members appointed by the mayor for definite and overlapping terms. Membership on these boards is a mark of distinction and members serve without salary. Members of commissions for various other purposes receive salaries. The board of estimates holds the purse strings and, together with the mayor, is the real power. On the whole this system has worked well and in many departments of the city government has given reasonably efficient service.

METEOROLOGY.

The climate of Baltimore is exceptionally fine, with an abundance of sunshine and rain and a comparatively low relative humidity. As a rule, severe storms are infrequent, prolonged droughts are rare, and extreme changes in

temperature develop gradually. These characteristics are due in part to the tempering influence of the Chesapeake Bay and in part to the fact that of the three great transcontinental storm areas, two pass well to the north, while the one following the southern course is moderated in its passage over the Southern States before it reaches the city.

The annual averages for temperature, precipitation, and relative humidity are 55.5° F., 43.18 inches, and 69 per cent, respectively. As on an average, the sun shines some portion of the day on 321 days in the year, gloomy weather is of rare occurrence. However, days with 100 per cent sunshine are uncommon at any season of the year, for on typical days the sky is partly covered with clouds. In winter the sunshine is 53 per cent of the possible amount and the relative humidity is only about 70 per cent. While high winds are rare, except in connection with occasional storms, the air in both summer and winter is usually in gentle motion. At all seasons, in association with calm or light winds from the direction of the water, fogs occur. They are rarely dense, and are usually of short duration.

The temperature is mild in winter, moderate in spring and autumn, and warm in summer. In table 1, compiled from data furnished by the local

TABLE 1.—*Average monthly temperatures in degrees Fahrenheit and the average precipitation in inches for the period 1871-1920 and relative humidity for the period 1888-1921, inclusive.*

Month.	Temp.	Precipitation.	Relative humidity at 8 a.m., 12 noon, and 8 p. m.	Month.	Temp.	Precipitation.	Relative humidity at 8 a.m., 12 noon, and 8 p. m.
			p. ct.				*p. ct.*
Jan.	34.	3.22	71	July	77.4	4.82	69
Feb.	35.4	3.51	68	Aug.	75.5	4.21	72
Mar.	42.3	3.88	66	Sept.	68.5	3.85	74
Apr.	53.6	3.27	62	Oct.	58.2	3.02	71
May	64.4	3.56	66	Nov.	46.3	2.92	69
June	72.7	3.84	68	Dec.	37.2	3.08	70

Average annual: Temperature 55.5° F. Precipitation 43.18 inches. Humidity 69%.

office of the United States Weather Bureau, are given the average temperature, precipitation, and humidity by months. It will be noted that while January is the month of lowest and July the month of the highest temperature, the difference between the average monthly temperatures of December, January, and February and between those of June, July, and August, is comparatively slight. The average temperature is above 60° F. between May and September, inclusive, and below this level during the remainder of the year. Excessively high temperatures are occasionally recorded in both May and October. On the whole the ascent of the temperature from the low point in January to the peak in July, and the descent through the rest of the year, follow rather regular gradients.

The curve of the rainfall by months is not so regular. During February and March the rainfall increases in amount decidedly over the level for January, falls significantly in April, and then rises gradually to its peak in July, the hottest month. By September the rainfall has decreased to the level of June, and

during October, November, and December, the driest months of the year, the monthly rainfall varies hardly at all. Measured in inches by season, the rainfall averages 3, 3.53, 3.55, and 4.25, respectively, for each month of the fall, winter, spring, and summer. Thus it appears that the monthly rainfall is about the same in winter and spring, but in the summer months it is much higher and in the fall months much lower, than in the rest of the year.

Humidity is lowest in April and highest in September. In July, the month of the highest temperature and rainfall, and in November, a cool month with the smallest rainfall of the year, humidity stands at the level of its average for the year. From 71 in January it declines progressively during February and March to 62 in April. Over the succeeding five months it rises steadily to 74 in September and remains relatively high, 71, 69, and 70, in October, November, and December, respectively.

Data concerning direction of the wind are given in table 2. For the year as

TABLE 2.—*Direction of the wind at Baltimore by seasons of the year, according to percentages based upon hourly observations and averaged for 11 years. (U. S. Weather Bureau.)*

Season.	N.	NW.	NE.	S.	SW.	SE.	E.	W.	N., NW., & NE.	S., SW., & SE.	Off land.	Off water.
											SW., W., NW., N., NE., & E.	S. & SE.
Winter	16	18	11	12	20	9	5	9	45	41	72	28
Spring	15	18	11	14	15	13	7	7	44	42	73	27
Summer ...	14	12	10	21	18	13	7	5	36	52	66	34
Autumn ...	16	16	10	15	17	11	7	8	42	43	74	26
Year	15	16	10	16	18	12	6	7	41	46	72	28

a whole, the wind blows from the northern segment for 41 per cent and from the southern segment 46 per cent of the time. During the remaining 13 per cent of the time due east and due west winds are almost equal in frequency. In winter, spring, and autumn, northerly and due westerly winds occur with greater frequency than do southerly and due easterly winds. In the summer months conditions are reversed, and the wind blows from a generally southerly direction for 52 per cent and from the northerly segment for only 36 per cent of the time, and decidedly less frequently from due west than from due east. These differences of wind direction in these two seasons are owing very largely to the higher percentage of due south winds and a lower percentage of due north, northwest and west winds in summer as compared with winter. This is a point of considerable importance, for as a general rule winds from the northerly segment are associated with cold or relatively cool weather and those from the south with warm or temperate weather. There is comparatively little seasonal variation in the frequency of northeast winds, which are often associated with rain at all seasons. The last two columns of the table show the occurrence of winds in relation to the river and Chesapeake Bay near the city. It will be observed that in summer the percentage of frequency of land winds falls and the percentage of frequency of winds from over the water rises decidedly as compared with what obtains at other seasons.

The average hourly wind velocity (table 3) is 6.4 miles. From June to December the wind velocity is below and from January to May is above the average for the year. The highest velocities occur in February, March, and April, and the lowest in June, July, and August.

The mean annual barometric pressure (table 3) is 30.05 inches. Though the extremes are not great the highest monthly pressures occur in the colder months and the lowest in the warmer months of the year.

TABLE 3.—*Average hourly wind velocity (51 years) in miles, and the mean sea-level barometric pressure (48 years) in inches. (U. S. Weather Bureau.)*

Month.	Wind velocity.	Barometric pressure.	Month.	Wind velocity.	Barometric pressure.
Jan.	6.5	30.13	July	5.9	29.98
Feb.	7.1	30.10	Aug.	5.4	30.01
Mar.	7.5	30.04	Sept.	5.6	30.08
Apr.	7.4	30.00	Oct.	6.0	30.11
May	6.6	29.98	Nov.	6.2	30.10
June	6.2	29.99	Dec.	6.3	30.12

These composite pictures of the general meteorological phenomena give, after all, an incomplete idea of the actual conditions, particularly in summer. The hills which surround the city on parts of three sides and the nearby large bodies of water to the south temper the winter in the city. The hills and valleys of the city itself are in general favorable for the circulation of air in the summer. In the main, the weather of spring, autumn, most of the winter, and part of the summer is ideal. Periods of two to three days to a week or two in summer characterized by an excess of heat associated with a high degree of humidity are not of infrequent occurrence. In these periods official afternoon temperatures of over 90° are commonly recorded, and in most of the built-up and in all of the low-lying parts of the city, particularly in the business and manufacturing sections, the temperature registers much higher levels. On these occasions, when, in the absence of breeze, the pavements and brick houses retain at night the heat absorbed during the day, in many parts of the city the atmosphere is stifling. Under these conditions, while relatively few deaths are ascribed definitely to heat-stroke, the death-rate from various causes, particularly among infants and the aged, rises significantly. Mortality from causes peculiar to early infancy and from gastro-intestinal affections of individuals under 2 years of age commonly reach the highest level in these periods. On the other hand, the heat of summer is usually mitigated by clouds, refreshing breezes, by day and night, and frequent thunder-showers. In the higher portions of the city, and particularly in the openly built sections in the hilly districts, excessively oppressive heat throughout the 24 hours is rare. The comparatively mild and short winter season exercises an important effect upon employment in all out-of-door work and especially in construction activities. There are relatively few days when workers are debarred from plying their trades, and on this account seasonal lay offs are of less importance than in less genial climates.

Chapter II.

Physicians and medical education; Hospitals and dispensaries; Charities; Dwellings; Schools.

PHYSICIANS.

Medicine and medical men have played an unusually prominent part in the life and development of Baltimore. Two of the five commissioners appointed to lay out the town were physicians, Drs. George Buchanan and George Walker. Three years later, the latter assisted in the founding of Jones Town, across Jones Falls, afterwards united with Baltimore Town. The four physicians in practice in 1756 included Drs. Henry Stevenson and Charles Wiessenthal, the first distinguished later as one of the foremost inoculators in America against smallpox, and the latter, universally revered as the Sydenham of Baltimore Town. From figures given by Quinan, the number of physicians resident in early Baltimore and their proportion in the population in different years were as follows: 1776, 19, or 1:355; 1782, 23, or 1:347; 1790, 30, or 1:450; 1799, 34, or 1:617; 1810, 46, or 1:1,012.

In connection with the rapid growth of the town and State in wealth and population during the last decade of the eighteenth century, there was an extensive invasion of medical quacks. In order to control these, a movement begun by Dr. Charles Wiessenthal of Baltimore and Dr. John Hall of Frederick resulted in the establishment in Baltimore of a medical society in 1785, and, in 1799, the Medical and Chirurgical Faculty of Maryland was granted the right by charter from the legislature to license candidates for medical practice after "a full examination before the board of examiners," or "in lieu thereof presenting a satisfactory diploma." The 101 incorporators, from all parts of the State, represented the best elements of the State and town and included men trained in the medical schools of Leyden, Paris, London, Oxford, Edinburgh, Glasgow, Aberdeen, and Dublin; but as late as 1807, of the 241 members of the faculty, only 17 per cent had medical degrees. Among the Baltimore physicians at the opening of the nineteenth century were men with names then and ever since of the highest standing in the city and State. The Medical and Chirurgical Faculty, in order of its foundation the seventh State medical society, has been closely identified throughout its history with medical education and public-health measures.

The faculty indorsed vaccination against smallpox in 1802, appointed committees of investigation and advice to the health department during the early yellow-fever epidemics, especially that of 1819, advised the mayor and the city council in regard to the health ordinances in 1820 and in other years, urged the appointment of public vaccinators in 1821 and the establishment of a State vaccine agency in 1864, and has taken an active part in securing acts of the legislature in regard to public health. The faculty did not long retain complete control over medical practice, for, under pressure of medical charlatanism

in the rapidly growing community, the powers of licensure after examination were withdrawn by the legislature, not to be regranted until 1892. Thus, for many years its power in this direction was limited to the influence of the high standard of medical ethics which it set up and consistently maintained. Baltimore has had its quota of societies and clubs devoted to the encouragement of general medicine, surgery, obstetrics and gynecology, pathology, and various other departments of medicine, many of them associated directly or indirectly with the Medical and Chirurgical Faculty. However, as it will appear later, the leading Baltimore physicians have ever been disposed to do their own thinking and to be guided by their own observations. In the later years of the eighteenth and in the earlier years of the nineteenth centuries they were inclined to repudiate the domination of contemporary British in medicine as in politics. Rush, the outstanding figure of American medicine in his day, seems to have carried but little weight with them. In later years Philadelphia, New York, and Boston were heard with respect. By the rising French school of the first half of the nineteenth century, and in particular by Laennec, Andral, Louis, Bretonneau, Rielliez, Barthez, Trousseau, and Charcot, they were slowly but markedly influenced. Not until after the intensive development of pathological anatomy and of bacteriology in Germany were Baltimore physicians much affected by the medical teachings of that country.

MEDICAL EDUCATION.

The first medical teaching of a formal kind in Baltimore was given during the winter of 1789-90 by Dr. George Buchanan in diseases of women and children and by Dr. Andrew Wiessenthal in anatomy, physiology, pathology, and operative surgery. The next year chemistry and materia medica were added to the curriculum of Dr. Wiessenthal's school. A program was issued, during the ensuing winter, of a medical faculty, consisting of Dr. Andrew Wiessenthal, anatomy; Dr. George Brown, practice of medicine; Dr. Lyde Goodwin, surgery; Dr. S. V. Coale, chemistry and materia medica; and Dr. George Buchanan, obstetrics. Drs. John B. Davidge, James Cocke, and John Shaw soon afterwards offered courses of lectures.

An important part of the original plan of the organizers of the Medical and Chirurgical Faculty was a school of medicine under the supervision of the organized profession, and in his address in 1801, the president of the faculty urged the adoption of a plan to organize such a school in Baltimore. In 1803, Dr. John B. Davidge, with Dr. George Brown and others, was appointed to consider a plan for the proposed medical school, but it was not until December 18, 1807, that the College of Medicine of Maryland, the fourth in the United States, was incorporated, with six professors. The cornerstone of the new college building, a handsome and, for those days, commodious structure, was laid in 1811, and in 1812 the college became the medical department of the University of Maryland. Among the early professors, John B. Davidge and Nathaniel Potter stand out as erudite and forceful men, who by their teachings and writings profoundly influenced the attitude of their contemporaries on questions of public health. The school, under the control of regents, was conducted with dignity and due sense of responsibility to the profession and to the community. An important reason for the great reputation it finally won was the fact that

the authorities did not hesitate to go out of town for teachers. In 1820, Granville Sharp Patterson and, in 1827, Nathan R. Smith were called to fill the chair of surgery. Elisha Bartlett was called to succeed Potter as professor of medicine in 1844, and he, in his turn, was succeeded by William Power, who, though a native of Baltimore, had spent three years with Louis in Paris. Until about 1890 this school stood among the strongest medical schools of the country in strength of the faculty and methods of teaching, and it fell to a secondary place only when it failed to establish strongly manned and well-equipped laboratories of anatomy, physiology, and pathology. Besides the Baltimore Infirmary, it had abundant clinical material at other hospitals.

In 1827, though there was no need for it, an ambitious group of medical men, led by Horatio G. Jameson, a man of force and talent, established The Washington Medical College, as the medical department of Washington College, Pennsylvania. This school, leading a precarious existence for many years, was succeeded by a proprietary school, The College of Physicians and Surgeons, at which some able men gave lectures and developed ward and laboratory teaching to a somewhat higher degree than at the University of Maryland. It used the clinical material of Mercy and other hospitals.

Later (1882), a second proprietary school, The Baltimore Medical College, was founded by another group of ambitious men, for whom no positions offered in the other two schools. With more modern buildings and stressing laboratory teaching, perhaps more than its rivals, this school drew a large number of students.

Lacking endowments, without reputation in medical research, unable to exert those other qualities that draw gold to the support of medical education, and their receipts cut by the decline in the number of students—due to the higher entrance, teaching, and licensure requirements demanded by the State examining boards, all three of these schools, about 1910, were not only unable to advance, but found their existence precarious. First the Baltimore Medical College and then the College of Physicians and Surgeons fused with the older school.

For some years a woman's medical college, established in 1882, led an uncertain life and perished because means were not obtainable to continue a creditable existence.

Between 1870 and 1885 there arose several obscure medical schools with pretentious names, all of them with the most primitive excuses for laboratory and hospital facilities.

All of these schools, except the University of Maryland, were founded by physicians ambitious for fees, but above all for the professorial title and consulting practice, and throughout their existence they were proprietary. The university, a legitimate child of the State, was established by the medical profession to fill a real need in medical education and was placed under the government of a board of regents, chosen, at least at first, from and by the Medical and Chirurgical Faculty. For the first 70 years of its existence, in its standards of ethics, teaching, and examination, it reflected truthfully the ideals of the best and brightest of the profession of the State. Since 1895 in teaching it has not, in a relative sense, maintained this position. The two other leading schools and the Woman's Medical College had on their faculties during their whole existence many men of the highest standing in the community and of

considerable professional attainment, and especially during the past 20 years, often at least, the equals in ability of the holders of their respective chairs in the University of Maryland. While, as a general rule, all these schools drew the bulk of their students from other States, and most of the better class of Maryland students attended the university, a not inconsiderable number of non-resident graduates of all of them settled in Baltimore, and many Baltimore students of deficient education graduated from the lowest type of proprietary schools—the diploma mills of the worst type. As a consequence of the relatively low standards of the four schools of the better type and of the debased standards of those of the poorest type, between 1875 and 1905, the medical profession was recruited by large numbers of relatively defective, ranging from bright men of college education and trained in the fundamental sciences but handicapped by poor facilities and opportunities offered by the better schools, through the gamut to the mentally slow and dull, whose opportunities in both preliminary and medical education were scandalously deficient. Medical practitioners of the same grades, both residents and non-residents, who had attended schools of all orders elsewhere, some of them graduates of foreign universities, completed the list. As a result of all these factors, there was added to the Baltimore profession, during the period of greatest activity of the proprietary schools, a considerable group of physicians deficient not only in the knowledge of physiology and pathology and the natural history of disease, but in modern methods of diagnosis and particularly in the principles underlying protective vaccination and serum therapy, defects which have left them a prey to the guile of pseudo-scientific manufacturers of drugs and biological products. One of the most striking evils of medical education in Baltimore during this period was a lack of practical teaching in obstetrics and in infant and child feeding.

Throughout its whole history from 1780 to at least 1890, except during a few years when the Medical and Chirurgical Faculty had control of medical licensure, the city had its share of advertising quacks and other medical charlatans. That all these untoward factors have made distinct contributions to the general death-rate and to the rates for certain diseases is beyond question. Nevertheless, it is probable that during this period until 1895 the general level of medical practice in Baltimore was at least as high as that of the Atlantic seaboard cities and much higher than that of cities to the west and south. This state of affairs was due partly to a few forceful teachers in each generation, to the natural ability of those who came to the top, and to the fact that on account of defects in their home teaching, many sought postgraduate instruction abroad.

After the founding of the Medical and Chirurgical Faculty and of the University of Maryland under its auspices, the most profoundly important beneficial influence upon medicine in Baltimore is that of the Johns Hopkins University, opened in 1876, the hospital in 1889, and the medical school in 1893. The influence of scientific investigation and laboratory teaching in physics under Rowland, chemistry under Remsen, zoology under Brooks, and physiology and histology under Martin was well established by 1880. As these men entered freely into the public and social life of the community, the influence of their ideas and methods and wide knowledge rapidly spread in intellectual circles,

of which the leading physicians formed an important part. Young men going into medicine took their courses and young medical graduates sought and obtained admission into their classes, particularly in chemistry and physiology and histology. Here Abbott, Councilman, and Booker, as postgraduate students, got their first training in microscopy; here also Sternberg did his early work in bacteriology.

Thus, the time and the settings were ready for the advent in 1884 of Welch, whose first courses were given in the biological laboratory. The brighter of the younger and many even of the established physicians during the next 10 or 15 years enrolled themselves in the courses in bacteriology and pathological anatomy offered by Welch and his associates in his pathological laboratory. Fortunately, Welch's courses were also opened to those undergraduates of the Johns Hopkins University who expected to study medicine. By these means, interest in the fundamental sciences in Baltimore was revived and rekindled. Young men entering medicine had opportunity to pursue them, and graduates in medicine as well were enabled to make up their deficiencies in physiology, microscopic anatomy, micro-parasitology, pathological anatomy, and general pathology. From these springs, medicine in Baltimore drank a revivifying draught. By 1890, Welch's students comprised directly or indirectly the whole medical profession of Baltimore, for there were few so ignorant or so fossilized that they could not absorb something of knowledge so simply diffused and imparted by this clear-headed, impelling master, whose kindly manner reassured the meek and abashed the arrogant. Whether it was the student who in the laboratory was encouraged to utilize the ample material, or the experimenter, to teach himself, or the physician in professional or social gatherings and in visits of consultation at his home, all took away a new conception of medicine and the inspiration to follow it. The most valuable service rendered at this time was to the brighter young medical graduates, who threw aside the medical text-books of the day and read in their stead the masters in medicine and the better articles of the current literature, and, freed from the dogmas and generalities of the schools and imbued with the spirit of observation, experiment, and critical analysis, thought for themselves.

The next important step was the opening of the Johns Hopkins Hospital in 1889, when the local medical profession received a salutary shock when made to realize that no one of them had so cultivated the medical sciences as to reach eminence of the kind and degree that would warrant the trustees to select him as head of a department of medicine, surgery, or obstetrics and gynecology. As a result, quite apart from their abilities, the newcomers had a crowd of pupils and voluntary assistants, eager to follow new leaders. The latter were fortunately chosen, and their influence upon medical and surgical research and practice, both within and without Baltimore, is too well known to need elaboration here. Since the tracing of the effects of the Johns Hopkins institutions upon the local medical profession is a part of this review, it may not be out of place to point out a phase that has not received the appreciation that its importance warrants. Perhaps the impression of the most fundamental importance made upon the band of Welch's pupils who followed the clinical branches in the hospital—and they were chiefly the ones who were best equipped to receive the new gospel—was gained in the surgical service of Halsted. There

under this master in surgery, they observed the methods of the laboratory constantly appealed to and applied in a manner wholly new and in a truly philosophical spirit. There they saw the aseptic technique carefully built up, the healing of wounds studied, and new operations developed, all under exactly controlled experiments.

Osler's influence was both deep and broad. Excelling in knowledge of the natural history of disease and of the fundamental relation between pathology and diagnosis, qualities that the local contemporary leaders in the profession prided themselves upon, he was in addition familiar with the chemical, microscopical, and bacteriological methods of diagnosis in which they were deficient. With these qualifications and his great gifts of mind and character, Osler at once assumed leadership and set new standards of diagnosis and of hospital and dispensary organization. His critical attitude toward the value of many drugs in the treatment of disease was largely responsible for winning the battle for expectant treatment and a fuller realization of the importance of *vis medicatrix naturae*.

Kelly's advent fell at a propitious time for obstetrics and gynecology, in which both teaching and consulting practice were very largely in the hands of relatively old men, who, however great had been their services in the past, unlike the general surgeons, were incapable of taking full advantage of antiseptic methods to extend the boundaries of their fields. Apt in acquiring the new technique and possessed of unusual natural and acquired surgical gifts and a peculiar combination of boldness and versatility of resource, he soon made radical advances in gynecology and set new standards of obstetrics in Baltimore.

The School of Nursing in the Johns Hopkins Hospital exerted almost immediately a beneficial effect upon nursing in the Baltimore hospitals and dispensaries.

The immediate effects upon the local medical schools of the Johns Hopkins Medical School upon its opening in 1893 were exerted directly in improving methods and facilities for teaching and indirectly in taking away most of the local medical students with college training. From this time on, it was clear that the graduates of the new school with its higher standards, exact scientific methods, and more ample facilities must turn out a new type of physician who would in time be the leader and dominate medical thought and action, and this prophecy was fulfilled in a remarkably short time. The transition was the easier because of the gradual leavening process that had been in progress since 1880. This process was evolutionary rather than revolutionary, and, owing to the good spirit of the leaders and mass of the profession, as well as of the teachers in the new and in the old schools, the metamorphosis was accomplished, on the whole, with remarkable smoothness and lack of bitterness. As a result, the profession held together without serious splits, and in the Medical and Chirurgical Faculty and other societies working in harmony, it was able to exert a salutary influence in improving medical practice and in securing remedial legislation and improvement in administrative measures in matters concerning the public health. The final result has been that in public confidence and influence, the medical profession of Baltimore, which always stood high, has outstripped all others.

The names of those who stand out after the lapse of time as real leaders and contributors to medicine in Baltimore are: Henry Stevenson, the inoculator;

Charles Wiessenthal, the educated physician, patriot, and medical reformer; James Smith, the vaccinator; Andrew Wiessenthal and George Buchanan, the early medical teachers; John B. Davidge, author and student and the father of the University of Maryland; David Meredith Reese, the student and historian of yellow fever; Ashton Alexander and Thomas E. Bond, advisers in public-health administration; Horatio C. Jameson, surgeon and student of public health; Pierre Chatard, the great obstetrician; George Frick, the eye surgeon; Nathaniel Potter, the medical philosopher and experimenter; Nathan R. Smith, Gibson, and Halsted, the surgeons; and Elisha Bartlett, William Power, Thomas H. Buckler, Charles Frick, William T. Howard, Sr., William Osler, and William D. Booker, students of the natural history of disease.

HOSPITALS AND DISPENSARIES.

Institutions of this type exert both direct and indirect effects upon the morbidity and mortality of a community. The beneficial influences of hospitals upon morbidity in furnishing asylum for the isolation of persons with communicable diseases occurring in the general population may be largely counterbalanced in improperly constructed and managed institutions by the spread of communicable diseases so introduced among their own populations. There is ample evidence that typhus, typhoid, and puerperal fevers, erysipelas, scarlet fever, measles, diphtheria, dysentery, and small-pox have often been so spread in the public and private hospitals in Baltimore. That hospitals have, at least within the last 100 years, tended to lower mortality may be conceded. On the other hand, hospitals, especially those widely known, with men on their staffs of considerable reputation in this or that branch, notably in surgery and its subdivisions, attract large numbers of non-resident sick—many poor operative risks and some hopelessly ill, an uncertain proportion of whom inevitably die in the city. Thus, hospitals of this class, which have been and are relatively numerous in Baltimore, by adding to the number of deaths of non-residents, have certainly been responsible for an increase in the gross number of deaths chargeable against the city. Dispensaries, besides serving as centers for the dispensation of treatment to the poor, have long been recognized as valuable aids to public-health administration, because in them often the earliest cases of certain communicable diseases in the community are discovered.

PUBLIC HOSPITALS.

The public hospitals of Baltimore have by their location exerted an apparently favorable, though really fictitious, influence on the death-rate, both general and specific, of Baltimore, since the deaths occurring in all of them at one time or another have been credited to the places in which the institutions were situated, rather than to the place from which the sick were sent. This was particularly true of the infirmary or hospital wards in connection with the almshouse, and the hospitals in connection with the quarantine station, all of which at one time or another have been situated beyond the limits of the city, and to all of which city patients with acute diseases have been sent. In the earlier period of the city's history, it is unlikely that the bodies of individuals dying at the almshouse, even of non-communicable diseases, were brought

to the city and buried in Potter's Field or other cemeteries. Since the tables of mortality were compiled from the reports of the sextons of cemeteries, until death certificates were required in 1875, and since, even after this time in some years, the large number of deaths at Bayview Asylum and Sydenham Hospital were excluded from the list of city deaths, and since it has been constant practice to exclude from this list all deaths at the Quarantine Hospital, these omissions are of considerable importance. The almshouse infirmaries served a double function in affording hospital care to some of the indigent sick in the general population, as well as to the sick among their own residents. Since the latter are recruited in general from those of middle or advanced age in the general population with a relatively short life expectancy, when the deaths among them are omitted from the city bills of mortality, it amounted to withdrawing from the city each year a certain number of poor risks and to subtracting the deaths among them from the total deaths.

The first public hospital was opened in 1776 or 1777 as an infirmary in connection with the large almshouse of Baltimore City and County, situated just without the town, near the present Richmond Market. There is no record of the number of beds, but the wards of the infirmary were certainly open to the sick poor without as well as within the almshouse. The almshouse and its infirmary were transferred to new quarters without the city limits at Calverton in 1823. The infirmary continued to serve as a hospital for the city poor, and it received cases of acute and chronic diseases. There was also an obstetrical ward and a ward for foundlings. The city authorities often used it as a pesthouse. Severe outbreaks of cholera occurred there in 1832 and in 1849. A vivid picture of the risks run by those sentenced to this hospital is given in the following quotations from T. H. Buckler's (11) description published in 1851:

"A single case of erysipelas brought to the house would often in a very short time, spread the infection to all the other wards, rendering it dangerous to perform the most simple operation, even that of bleeding. The slightest wound was sure to be followed by erysipelas, phlebitis, and in some instances, gangrene, and all this was attributed to hospital atmosphere. Was it the air of the wards alone, or other causes, which produced these results? The establishment affording no facilities for isolation, it was not unusual to see in the same ward, at the same time, cases of typhoid fever, erysipelas, dysentery, and typhus or ship fever. And it repeatedly happened that patients admitted with pneumonia, pleurisy, or some other acute affection were seized, before their convalescence was perfectly established with some one of these morbid poisons, which, in the weak state of their systems, too often proved fatal. It is at best but poor humanity to send a man to a charity hospital, to get rid of one affection, and at the same time, place him under circumstances where he is very likely to contract a much more dangerous malady. . . . . In 1844, and again in 1845, when the house was under the care of Professor Power, of the University of Maryland, the poison of puerperal fever was so intense that death was sure to ensue in the case of every lying-in woman, the attack commencing usually in from 4 to 12 hours after parturition. In each of these years, some 8 or 10 cases consecutively proving fatal, this ward was abandoned, the women expecting confinement were sent to the Washington College Hospital, and no other cases of the kind were admitted for a period of 6 months. Every summer the children suffered from cholera infantum, and where they escaped this disease, they were almost sure to perish in the winter with pneumonia. In the whole history of the establishment there is no single example of a foundling that has lived to the age of 3 years."

A shift was made to a new and commodious plant at Bayview in 1866, the mixed almshouse and hospital features being preserved. During the last 20

years extensive additions and improvements have been made, including a separate general hospital for general diseases of about 150 beds for the city poor. There was established also a separate tuberculosis hospital for advanced cases. For many years there has been a pavilion to accommodate the insane among city residents, for whom the State insane asylums did not afford room.

In 1797, the legislature authorized the erection in or near Baltimore of a hospital for indigent sick and lunatics. This hospital, variously known as the Public, City, or Maryland Hospital, was located without the city limits of that time, on an elevated site, now occupied by the Johns Hopkins Hospital. It was opened in 1800, when about one-third completed, with 130 beds. It was leased in 1808 to Drs. Colin McKenzie and James Smith for a period of 15 years, and in 1814 the lease was extended on condition that the lessees would complete the central building, a lunatic asylum, and an additional hospital wing. It was to this hospital that yellow fever patients were sent in during the epidemics between 1800 and 1819. In 1814, 234 sick and wounded soldiers were received, after the battle around Baltimore. The courts began to commit the insane to special wards of this hospital in 1807. Clinical lectures were given in the hospital in 1818 by Professor Nathaniel Potter, and in 1822 by Drs. Colin McKenzie and George Frick. By the annexation of 1816, this hospital came within the limits of the city.

Between 1826 and 1834, additional buildings were completed, the administration of the hospital passed to the State, and admissions were limited to the insane. It appears that for some years before the latter date this hospital had admitted sick sailors and immigrants with certain communicable diseases. This institution was finally abandoned as an insane asylum after the completion of the new State Hospital for the Insane at Spring Grove in 1854, and the property was soon afterwards purchased by Mr. Johns Hopkins, and later became the site of the hospital founded by him.

The account of the quarantine hospitals will be given in connection with the quarantine station.

During the cholera epidemic of 1832, the health department conducted three improvised hospitals, and about 1835 it opened a small-pox hospital, which, in 1837, was leased to the Washington Medical University, with the provision that when necessary a certain number of small-pox patients would be received at a stipulated per diem charge, an arrangement held to until the opening of the marine hospital of the quarantine station in 1847.

For a number of years the city has paid a small per diem charge to a number of private hospitals for the care of indigent sick, for whom no room was available in the almshouse infirmary.

In 1909, Sydenham Hospital, with accommodations for 40 cases of diphtheria, scarlet fever, measles, and chicken-pox, was opened. In 1914 it was expanded to accommodate 60 patients.

PUBLIC DISPENSARIES.

The city has supported several general dispensaries for the treatment of the poor. The most important of these and the dates of their foundation are: The Baltimore General, 1808; the Eastern, 1818; the Western, 1847; and the Southern, 1847.

PRIVATE HOSPITALS.

The hospitals placed under this heading were built and conducted not by the city authorities, but by chartered corporations, and their chief and in some instances sole source of support has been derived from gifts and endowments and fees of patients. Many have succeeded in securing appropriations from the State. Most of them have received small per diem payments for indigent patients, for whom room was not available in the city-owned hospitals, and at times, for some hospitals especially, this has been an important item until recently. Nearly all of these hospitals throughout their history have posed as charitable institutions, created and maintained primarily for the care of the poor, but in most instances even cursory investigation shows that this is not true. These institutions readily fall into distinct categories:

(1) There are those institutions started in connection with medical schools, the primary aim in the foundation and conduct of which was clinical material for teaching students, a theater for the professors, and hospital accommodations, particularly private rooms, for the patients of the latter. From the start they were important to the medical-professor business. The first hospital of this class, the Baltimore Infirmary, was founded in connection with the University of Maryland Medical School and opened in 1823 with 4 public or free wards. There was a considerable enlargement in 1850 with private rooms. Later expansions have greatly increased the total accommodations for both free and pay patients. This general hospital has maintained an obstetrical service for many years, housed in a separate building since about 1885, and at one time had a ward for acute contagious diseases, where patients from steamship companies were received on contract. The second was that of Washington Medical College, established in 1838 and closed with the failure of the school in 1851. The small so-called City Hospital was developed by the College of Physicians and Surgeons after 1878, and about 1890 it was taken in charge by a Catholic sisterhood, which has been largely responsible for securing funds and for elevating it into a large general hospital. However, the private rooms for paying patients of this hospital form a very large part. This hospital, with its large dispensary service, was the main source of clinical material for the college whose professors formed the medical and surgical staff. The Maternity, a small lying-in hospital, the first separate hospital of its kind in Maryland, established in 1878, was conducted under the control of the same faculty. The Maryland General Hospital, a small hospital with a few private rooms and public wards, maintaining a precarious existence, was annexed by the Baltimore Medical College in 1881, and during the meteoric career of this college expanded rapidly, and with the expiration of the latter in 1914, the hospital absorbed the college buildings. Here a maternity ward and a large dispensary service were maintained so long as clinical material for teaching was needed. The religious sect chiefly appealed to for support is the Methodist. The Woman's Medical College also conducted a small hospital. A hospital of considerable size was supported for many years in connection with the Homeopathic Medical College.

(2) Hospitals built and maintained by private associations, usually more or less identified with religious sects, many of them receiving larger or smaller appropriations from the State either for buildings or maintenance or both, form a second class. The earliest of these was the Union Protestant Infirmary, a small

hospital opened in 1854, with private rooms and open wards, for charity and part-pay patients. Since 1895 it has undergone considerable expansion and has become very largely a surgical hospital. The old college and hospital of the defunct Washington Medical University were organized into a church home and infirmary in 1854, under the auspices of the Protestant-Episcopal Church, and in recent years, with considerable additions, it has become an important hospital, with the traditional private rooms for pay patients, chiefly surgical. St. Joseph's Hospital, founded in 1864, and St. Agnes Hospital, the latter until recently without the city limits and organized in 1878, both supported and managed by sisterhoods of the Catholic Church, have grown from small beginnings into large and relatively well-equipped hospitals receiving both free and pay patients. St. Joseph's Hospital conducts a large free dispensary. The Franklin Square Hospital and the South Baltimore Hospital are small general hospitals with open wards and private rooms. There are several special hospitals for eye and ear diseases, the oldest and most prominent being the Presbyterian Eye and Ear Hospital, founded in 1871, with 20 free beds and private rooms. As its name suggests, its special support comes from the Presbyterian Church, the religious sect of its talented first surgeon-in-chief. The Woman's Hospital, founded in 1882, with an appropriation from the State, for the treatment of the special diseases "of the poor women of Maryland," modeled on the famous hospital of the same name in New York, with a staff of two chief and four assistant gynecologists, and governed by a board of trustees and a board of lady managers, opened with only free beds. A few years later, against the protests of one of the chief gynecologists, rooms for private pay patients were added. Since 1908, this hospital has expanded into a large hospital composed almost altogether of private rooms for pay patients, receiving cases of all affections among women usually admitted to a general hospital; and with its heterogeneous staff, it has lost completely its original features of a free hospital for the treatment of women of Maryland, suffering with diseases peculiar to their sex. Though the plant has been greatly enlarged, scarcely any more patients of the character for which it was founded are now accommodated than were a few years after it was opened.

(3) There are also hospitals built and maintained by endowments from private individuals, founded and conducted to relieve the indigent sick and those who can afford to pay, with charges to the latter, either in public or private wards, graduated according to their means. The Robert Garrett Hospital for Children was founded in 1888. This hospital, with modern equipment and a large free dispensary service, accommodates 30 children with medical and surgical diseases. The large and constantly expanding Johns Hopkins Hospital, a model of its kind, with accommodations for both pay and free patients, and well-organized general and special dispensary services, was opened in 1889.

CHARITIES.

Baltimoreans have always been notable for charity, and here, as elsewhere, organized charity began with personal relationships, religious organizations, and race groups, and developed later into special and general relief systems. The public treasury was successfully appealed to first for special needs and later

for systematic help. It is beyond the scope of this work to give more than the barest outline of charities and charitable institutions as they have had a direct bearing upon public health and mortality.

While in the long run it may be true that in old settled countries, where the laws of the relation of population, including health and mortality, are so closely bound up with subsistence derivable from home lands or purchasable abroad with money gained in trade, manufacture, and other services, the preservation of the lives of the very poor by private and public charity is useless and even immoral; still, in a new country and particularly in a town and city so situated as Baltimore, where, in general, the restrictions on population growth by propagation have been relatively slight, it is probably correct to assume that, on the whole, benevolence administered to the needy and unfortunate, either in large groups under special conditions or to smaller groups and to individuals routinely, by tiding them over difficulties in times of special stress, has so far tended to increase of population and to lighten or at least to deflect the force of mortality.

The English system of tax levies by law officers for the support of the poor was applied in early Baltimore, as well as in the rest of the colony. In 1773, to do away with the abuses of the system, a loan of £4,000 was made by the State to Baltimore Town and County for the building of an almshouse, to be administered by a corporate body, the Trustees of the Poor, and in connection with it, there was a workhouse for the reception and lodging of vagrants or other offenders committed. This almshouse, erected first on a large lot of land near the present Richmond Market, moved in 1822 to Calverton, and in 1866 to Bayview, has remained a permanent feature of Baltimore municipal charity, and during its existence has carried a large proportion of the poor and destitute, for whom it has always maintained an infirmary, into which have also been received indigent sick directly from the general population. For many years, the Trustees of the Poor supported a few pensioners without the almshouse.

Since early days there have existed a large number of homes for old people and orphan asylums for children of each sex, often with associated schools. They are usually identified with some religious sect or racial organization, and several have accumulated handsome endowments.

About 1800, societies, based on racial ties, were first organized to help, advise, and protect individuals of certain races and their descendants. The most important were the German (1784), the Hibernian and the St. George (1803), St. Andrews (1806), and the Hebrew Benevolent Society (1834). Out of all these, various benevolent activities have grown.

The great increase of immigrants during the fourth and fifth decades of the nineteenth century included many who were destitute, and by 1849, poverty and even pauperism having become a very serious question, the Association for the Improvement of the Poor was organized on a broad and representative basis. This was succeeded by the Charity Organization Society in 1881 and the Federated Charities in 1908. In the meantime, during the Civil War, the calls upon privately supported charities had become so overwhelming that a number of these agencies found it necessary to obtain aid from the city government. In 1870, 7 institutions received $22,000 city aid, and by 1896, 51 were dividing $277,275.

The St. Vincent de Paul Society, growing out of parish conferences in 1865, incorporated in 1869, and since widely extended, is the representative Catholic society for general relief. It is closely affiliated with the large number of orphanages, homes, schools, and other benevolent institutions maintained by members of the Catholic church. Two of these, in which large numbers of children have been received, are the St. Vincent's Orphan Asylum and St. Elizabeth's Home for Colored Children, the latter established in 1879.

The most conspicuous endowments for public aid have been the Henry Watson Children's Aid Society, $100,000 (1880), and the Thomas Wilson Sanatorium for Sick Children, $500,000 (1880). In close connection with the latter, operates the Babies' Milk Fund (1904), with its large number of welfare stations and nurses for babies. These two institutions have doubtless exercised a large influence in late years in decreasing the mortality among the young.

During the last 20 years, charity and benevolent societies have multiplied, expanded, and coordinated, and have covered the field of nursing, tuberculosis, playgrounds, athletics, and the like. Many local and city-wide associations for general betterment of living conditions have been formed. Among the most active of the latter is the Woman's Civic League, which has exerted an important influence on measures to promote the public health, especially in connection with improving the milk-supply. The union of 14 of the more important benevolent organizations in the Alliance of Charitable Agencies in 1914 has resulted in expansion and better coordination of city-wide benevolence. The Hebrew Benevolent Association, upon which unusual demands had been made on account of the large influx of oppressed Jews, particularly from Russian Poland, during the past 30 years, had already consolidated and expanded their work in a manner somewhat similar.

Fraternal societies of various types have always been numerous and strong in Baltimore.

Speaking broadly, the private and semi-public benevolent associations and their correlated institutions have become grouped about three great religious divisions, Protestant, Catholic, and Jewish, among which, however, the rivalry is friendly and to a remarkable degree cooperative and free from prejudice. The problems of the Catholics have been especially complicated, because of the differences of race-stock and language, which tend to cause and to perpetuate social isolation of large groups, such as, Poles, Italians, Bohemians, Lithuanians, and some others, who are still largely in the first and second generations, and among whom benevolent associations must naturally incline toward race-stock groupings. These problems obtain to but a small degree among Protestants.

The great nationality or race-stock benevolent societies, such as the Hibernian, the German, the St. Andrew, and St. George Societies, agents of such great importance in earlier days when organized to relieve the imperative necessities of recent immigrants, have, with the decrease in the latter and the general improvement in conditions, naturally diminished in importance as relief organizations.

There are no conspicuously large benevolent associations conducted and supported by negroes alone, though they have their share of fraternal orders and benevolent activities, especially in connection with their churches.

Accident, sick, and burial insurance in both local and foreign companies is very prevalent among the whole population of Baltimore.

In review it may be said that, at different times, especially during and after wars and very large immigrations, there has been acute suffering from poverty which has been met in part by general philanthropy, by special organizations, and by contributions from the public treasury in a degree sufficient in the main to prevent starvation and any large actual loss by death; that benevolent associations, special and general, have protected the unfortunate, usually without nursing and increasing pauperism; and that during its whole history provision for the relief of want has been made from the public treasury, and the tendency during the last 50 years has been to call on the latter in increasing proportions and to consolidate and to coordinate the various private and semi-public benevolent agencies.

SCHOOLS.

The public school system was established in 1826, but before and since this date there have been a number of private schools. On account of the large proportion of Roman Catholics in the population, the parochial schools, attended by a considerable moiety of children of Catholic families, are of more than usual importance. So far as the buildings for this purpose are concerned, there is no reason to suppose that those of the parochial schools differ much from those supported by the public treasury. The public schools are divided into kindergarten, grammar, high, and technical schools. They are conducted under a board of school commissioners. There are separate schools for whites and negroes.

In 1850, according to Wynne (12), there were 25 schools, 11 male and 14 female, with 2 female and 1 male high schools. In 1848, the number of pupils (all white) was 6,693, or about 260 pupils to a school. Wynne described the schools of this day as filthy dirty, crowded, and ill-ventilated. At that date the Brothers of the Christian Schools, the Brotherhood of St. Patrick, and McKim's Free School (endowed) accommodated some 2,000 additional pupils. During the days of the clipper ship, the school authorities conducted a nautical school, with a ship, for the training of boys for the sea.

During the next 60 years there was some improvement in the physical conditions of the school-buildings. In his report for 1908 to the Commissioner of Health, Dr. H. Warren Buckler, as medical inspector in charge of a group of 20 schools, which he regarded as typical, classed them as follows in regard to design, structure, cleanliness, and ventilation: First class in every respect, 2; average, justifying neither criticism nor praise, 10; modern well-designed buildings, but unclean and offensive on account of the personal habits and lack of cleanliness of the pupils, 4; totally unfit for educational purposes, 4. In schools of the latter class the school-rooms were too dark for the pupils to see the blackboard, the desks were misfits (all of the same size and non-adjustable), the buildings were dirty and without proper toilets. The overcrowding was conspicuous; in a room picked at random, with a floor space of 18.5 by 12.5 feet and 2 windows, there were 40 pupils. One of these schools, used for negroes, beggared description. The new schools Buckler described as models for their purpose. Thus, according to his report, it would seem that of the public-school buildings 20 per cent were entirely unfit, 50 per cent were passable, and 30 per cent were to be condemned. It is probable that these were typical samples

of the whole number of public schools of the city. Few are situated on or near small parks. A few of the schools have large yards, but for the most part the playground space is seriously restricted. Largely through the initiation of Dr. Buckler, within the last few years "open-air" schools for delicate children have been established in connection with several schools.

From the reports of the different medical inspectors, the same conditions as to structure and overcrowding obtain in the parochial schools.

There are a large number of private schools, both elementary and preparatory for college, for both boys and girls. The general hygienic conditions of these are good, and some are models. They are attended by a larger proportion of children than is usual in an American city.

DWELLINGS.

The earlier dwellings of Baltimore Town were of wood; the first brick house was built in 1740. It was not until after the rapid growth of the town after 1780, in an area surrounded by natural obstructions to expansion and under conditions demanding warehouses and residences near the water-front, that the construction of brick dwellings in closely built blocks became the custom. Wood was abandoned as a building material because of danger from fire, and brick was adopted on account of the great abundance of excellent clay near at hand. Stone, plentiful in nearby quarries, was often used in foundations and for public buildings, but was never a serious competitor of brick in dwellings and warehouses.

The early streets being comparatively wide, the rectangular squares into which the town was laid off afforded ample space for the erection of houses of two or three stories in height in compact blocks with sufficient provision for light and air, front and back. The squares are usually cut by one or several, usually two, alleys varying from 3 to 10 or even more feet in width, which give convenient access to the rears of the houses fronting the streets on the four sides of the squares. The end houses of a block, with the street or alley alongside, may have light on three sides. Since the squares measure about 300 feet on each of their four sides, and the houses commonly abut the paving line, there is ample room for a comparatively deep yard behind each house. The lots carry ownership to the center of the alley alongside or in the rear, the alleys being private property dedicated to the convenient use of the occupants of abutting houses. The streets vary from 30 to 80 or more feet in width from house to house. Since the stage and wagon roads from north, south, east, and west, led to the water-front and were necessarily broad to accommodate the heavy traffic wagons plying in and out of town, with the growth of the town along them, they served as wide avenues radiating from the lower city like the ribs of a fan, sufficiently distant from each other, however, not to interfere seriously with the regular arrangement of streets running north and south and east and west.

The dwellings of the typical city square of the better sort abut the foot-pavement and are placed often in unbroken rows, for the whole length of opposite sides of a street. In this case the block is bisected by a single 10 to 20 foot alley, directly in the rear of each row of houses. The four houses at the corners

of the square have light and air on three sides and all the rest on two sides. The whole center of the square is open, except for the board fences which separate the yards in the rear of each house. In other cases, blocks of houses, some with less deep yards, will face three or even four sides of a square, which in this case will be traversed completely or incompletely by a second or even a third alley at right angles to the first. In this case, several more houses, placed necessarily alongside of alleys, will have three free sides. Each yard opens upon its bordering alley by a gate. Only occasionally in the closely built up sections of the city are any of the houses completely detached, but not infrequently in the richer districts there will be one or more side-yards where owners have double lots, or front yards when the houses are set back from the street. Since a lot may be at least 150 feet deep, even large, deep houses may be separated by at least 100 feet from rear to rear in a block with a single bisecting alley. In houses so situated, the amount of light and air available for each house depends entirely upon its design and the width of the lot.

From these optimum conditions, there is every variation to closely built squares with nearly every available foot occupied by buildings, the mass of which are used for human habitation. In the first place, in the best squares there are often stables and coach-houses, or in recent times garages, at the rear of some of the lots. The latter, in older parts of the city, often were also the seat of large or small houses or "quarters" for domestic servants—negro slaves in former generations. In the poor districts of the city, especially in the south and southeastern sections near Jones Falls and the harbor and the basin, but abundantly found as foci in nearly all parts, there are numerous squares almost solidly built. In general, this has occurred in one or both of two ways: (1) By building a single or double row of houses along the intersecting alley or alleys or houses about closed courts within the square; (2) by additions on the rear of the original houses. Many such built-up alleys, 8 or 10 feet wide, extending through a number of squares and later accepted by the city, have been dignified by the name of streets. These alley and court dwellings have existed in the oldest sections of the city from at least the latter part of the eighteenth century, and these types of intra block building have so extended that in the lower southern, southwestern, and in much of the western districts they are characteristic features. It is not unlikely that they are inhabited by as much as one-eighth of the total population. The crowding of squares by the additions to the rear of dwellings facing streets is of more recent origin, but in many parts of the city, particularly in the southeastern segment, extending on both sides of Jones Falls down to and including Fell's Point, this condition has existed for many years. As a result of this type of building activity in many squares, at least four-fifths of the surface is covered with rambling and interlocking buildings, attached to the rear of old residences; all, except when the front lower rooms of the latter are transformed into shops, are used as dwellings.

In the older sections of the city near the water, especially at Fell's Point, there remain dwellings typical of the early city. These range from single-room houses and two-room 1 or 2 story houses to mansions of 10 or more rooms. The single room, two, three, and four-room houses were built on broad as well as on narrow streets and on alleys and courts. The early small houses had com-

paratively small windows, but they were well built, and as houses or dwellings, apart from lack of light and air when closely grouped in alleys and courts, were fit. It was the six or nine room house, with three rooms to the floor, that was so often especially ill-suited in design for health. In many of these houses the entry is direct into the front room, which opens into a center or hall room without windows. The back room is either dining-room, with a single window and a narrow kitchen behind, or combination dining-room and kitchen. From the center room run the stairs, and on the two upper floors there is often a central room without windows, but in some houses of this class there is ventilation of these rooms by windows on shafts or by skylights. It is possible that these dark rooms were not used for sleeping-rooms, but as hallways and as closets, by the first occupants. Certain it is, however, that when these houses passed into the hands of poorer people, especially recent immigrants, the dark rooms came to be used as living and sleeping quarters. It was against this type of house especially that the ordinance of 1886 was intended to apply. It is likely that, by this time, houses of this type had long since ceased to be built. The common device used in lighting the middle room of a house three or more rooms deep is to have a space for a rear window in the middle room, by narrowing the back of the building, the rooms in the latter in turn being lighted by side, or, in the case of the last room, by end windows. The lower hall, now almost invariably the entrance, receives light from a window light in the front door, and the upper halls from a broad transom in the roof. In this way, among others, fairly well lighted and ventilated houses are constructed in close blocks. In many houses there is no or only one room over the back building, on floors above the first. The larger houses of the richer classes, varying greatly in design, are characterized by comparatively large rooms with very high ceilings, but in many one or more of the rooms on each floor are lacking in light. In them, however, attic rooms, often used as bedrooms for servants, were often dark or lighted only by skylights. In many of the smaller houses built after the ordinances of 1886 and 1908, rooms on the second and third floors, used as sleeping-rooms, are lighted only by immovable skylights and are thus defective in ventilation.

The houses for the most part have cellars for storage and for heating-plants under the main structure. In many parts of the city, especially upon made ground and in the lower sections and elsewhere, on account of the numerous springs, much difficulty has been experienced in keeping cellars dry. On this account the early ordinances prescribed methods of construction intended to prevent access of water to cellars, and automatic drainers have been used to dispose of water entering cellars by seepage. From early times, in both small and large houses, in higher parts of the city and especially on hillsides, half cellars or basements with half or less than half their height below the surface of the ground and lighted by windows, have been used not only for basement kitchens and laundries, but for dining-rooms and, among the poorer people, as sleeping-quarters. In the older, larger houses, occupied by people who can afford domestics, the basement kitchen is the rule. These are usually well lighted for their purpose by ample windows.

The typical block dwelling of the last 75 or 50 years is from 14 to 18 feet front by 30 to 35 feet in depth, and of 2 to 4 stories. The cellar or basement,

lighted by windows in front and behind, and in end houses on one side, has a furnace-room with storage space for fuel, a kitchen at the rear, and sometimes a laundry. On the first floor is the narrow entrance hall, approached from the street by stone steps and lighted by a large window-light in the front door. Opening on the hall is the comfortable front parlor, with its one large or two smaller windows looking on the street. Behind this is the dining-room, entered from the hall or parlor or from both. This room is poorly lighted by side windows, if the kitchen, as is sometimes the case, is on the first floor, or by one or more rear windows, if a first-floor kitchen behind the dining-room is narrower than the latter. If the kitchen is in the basement, the dining-room will, in the absence of a back building, be well lighted. A center room, poorly lighted from the dining-room, or from a narrow area window, is not uncommon. The stairs lead from the entrance hall to the second floor, with its front bedroom occupying the whole width of the house, or with a space the width of the first-floor hall forming a bath and toilet room. More often the bath-room is in the center of the house, off the stair landing, if there is an area light, or in the rear over the kitchen. The rooms over the dining-room and kitchen, if there be one, have ample windows. The third story resembles the second. The kitchen wing may have on the second floor a bath-room and one or more bedrooms with adequate light.

There have always been, beyond closely built up sections, larger and smaller detached houses, with ample windows, and often surrounded by large grounds and even parks. Many fine suburban homes have had to give place in the course of time to the growing city. In the last 20 or 30 years, there have grown up in the northern and western suburbs, especially, large settlements of detached houses with large grounds and ample shade trees, resembling the New England town or the western cities, but on the whole, the extension of the city into the suburbs has been characterized by the building of rows of block houses.

HEATING.

All single dwelling structures built, until very recent years, had in nearly every room a fire-place, in which was burned either wood or coal, or to which a stove was attached. During the last half of the nineteenth century, latrobe stoves (burning hard coal, one set in the parlor and one in the dining-room, and fitted with flues to convey heated air to the rooms above) were very generally used. First in large and later in small houses, these gave place to the cellar furnace, heating first by hot air and later by the usual steam or hot-water radiators. Wood or coal fires are still much used in living or sitting rooms by those who can afford them.

TENEMENTS.

The comparatively few large tenements of the traditional type are poor in design and structure, and the same is to be said of those made by remodeling and adding back buildings to large and often handsome old dwellings, from which the owners or occupiers of former days have moved. Tenements of both these classes abound in dark hallways, narrow passages, and dark, ill-ventilated rooms, and the buildings often occupy nearly the whole of the lots. In some

districts whole blocks of houses have been remodeled into crowded tenements. Tenements of this type are most common in the old part of the city in the district south of Saratoga Street, along Jones Falls (both sides), and extending well into Fell's Point; on Lexington and neighboring streets for some distance west of Lexington Market; and in sections bounded by McCulloh Street on the east and Orchard Street on the south, and extending north and west, particularly along Druid Hill and Pennsylvania avenues. Tenements and similar several family dwellings of these classes are occupied for the most part by people of the recent migrations, especially Polish Jews, Hungarians, Russians, and some Poles, and others, who, on account of their comparative lack of means, have had on their arrival to take such quarters as were available. As they prosper, they either take better quarters, or move into single-family dwellings. The large tenement buildings so common in New York and in many foreign cities are totally lacking in Baltimore.

Lodging-houses.—The practice, particularly among families with comparatively large houses, who for one reason or another desire to add to their income, to let one or more rooms to lodgers, with or without meals, has been common in all sections of the city, and there are also large numbers of typical boarding-houses. In many such cases this practice leads to the use by the family or by the lodger of crowded quarters, often in dark rooms. In recent years many immigrants have crowded whole families into one or two rooms rented from families of their own nationalities. This custom is said to be particularly common among Poles, Polish Jews, Russians, Lithuanians, and Hungarians.

A lodging house of another type is the 5 or 10 cent house, accommodating men on the floor, bunks, or beds, and commonly styled "flop-houses." These are fairly numerous near the water-front, and are patronized by seamen, oystermen, ne'er-do-wells, and occasionally by tramps. Their population has been relatively small.

APARTMENTS.

In recent years, many large and small apartments have been constructed, and numerous old houses have been transformed into apartments. All of these, as in other cities, vary widely in the space, light, and ventilation they afford, and many sections of the building code of 1908 were aimed at the control of these and of the lodging and boarding houses.

LAW ENFORCEMENT IN REGARD TO LIGHT AND AIR IN DWELLINGS, AND TO PREVENT OVERCROWDING.

The laws on these matters, which date only from 1886, have at no time been systematically enforced. The building inspector's office has passed on plans permitting dark rooms and improperly lighted and ventilated rooms in block houses and in apartments, in direct contravention of the ordinance of 1908. The activities of the Health Department from 1916 to 1919, at least, in regard to boarding and lodging houses and apartments, have been confined to endeavors to enforce the requirements in regard to cleanliness, toilets, and the like.

There are not now, and there never have been, any accurate data concerning the proportional distribution of the population among good and poor dwellings.

In periods of very rapid growth in population, housing conditions probably always have been inadequate, with resulting overcrowding. This has been the fault of the immigrants, for no reasonable person could expect the residents to anticipate population movements and provide beforehand for uninvited guests. The immigrant comes at his own risk of finding a home and the means to support it, and he recognizes these limitations. Residents build houses to meet demands of those with money to fill their wants, and doubtless often before, as from 1910 to 1915, there were in Baltimore many unoccupied dwellings. Certainly during that period there was no excuse for overcrowding, though this existed in many parts of the city. How much of this was due to choice and how much to inability to pay moderate rents it is impossible to estimate accurately.

It may be assumed with safety that, throughout its history as a city, the great mass of the white population has been reasonably well housed, and that since an early date most of those of Anglo-Saxon descent have lived in well-built one family dwellings, much superior in room, air-space, and light, at any given period, to those obtaining in most European and other American cities.

Representatives of other white races have established themselves on the whole on the same footing, after immigration, as they have found means. The Germans, German Jews, Irish, Bohemians, and the Italians have achieved this station in the order of their coming; other races are in process.

The description of Wynne (12), written in 1850, except for the last sentence, applies substantially today:

> " The houses occupied by the laboring classes have usually a 16-foot front, a depth of 30 or more feet, are two to three stories high, and are unvariably of brick. Behind the main building, there is usually a back building of the same height, and a yard with a privy and a hydrant. (Both these now displaced in favor of interior toilets and water-supply.) These houses are for the most part occupied by single families, but are sometimes underlet to poor persons. The system of a number of families occupying the same house does not prevail to the same extent as in some other places and is confined to the very poor. Whole streets, however, in the western part of the town are occupied by a wretched population, crowded together in a most unseemly and unhealthy manner."

In so far as the last sentence applies to whites, it is probable that it fitted the great number of Irish and German immigrants forced to leave their native lands during the previous few years and who had been here too short a time to establish themselves. The same fate of necessity overtook the crowds of Polish Jews who arrived in the last two decades of the nineteenth century. This must always have affected those immigrants whose coming was influenced more strongly by repellant than by appellant forces, but in each case they have no doubt found the housing conditions much better than those they left.

It has been with the negro, however, that poor housing conditions have been especially associated, and in many ways with truth. It is difficult to decide which on the whole was the better (or the worst) housed in Baltimore, the free or the slave negro. For a certain period the death-rate was greatest among the latter. There was every incentive for the masters of slaves to house them as well as practicable, and many of the free negroes, both before and after 1865, were skilled artisans and earned good wages. For the latter, the chief reason for alley residence was not financial but social. Indeed, there are many rows of alley houses fully equal and often superior to many " street houses," and when

the family is not too large afford healthy dwellings. Again, within the last 20 years, many negroes have lived in well-built, large houses, on wide streets, fully the equal of those of many of their white neighbors, and in every way superior to the crowded dwellings of many of the more recent white immigrants. In every way the negro's status is racial; whatever his means, he was often limited to alley dwellings, because on account of opposition of the whites he could not gain entrance to a street block. In most neighborhoods, when one or two negro families succeed in getting a house in such a block, the whites will move out, and the whole block will in a short time be inhabited by negroes. Thus they have gained block after block in many streets. It is certain that the negro, on the whole, during the last 10 or 20 years, has been better housed than many whites of several races of recent arrival.

Ownership of the home has been a marked characteristic of Baltimoreans. This has been facilitated by the ground-rent system, by which occupation of land is obtained without immediate capital outlay, the cheapness of building, and the large number of savings banks and building and loan associations, ready to lend money on liberal terms for home-building and home-owning. Whereas in some quarters of the city many houses, even blocks of houses, are owned and let by large estates; in general, building has been carried on by contractors with a view to immediate sale to occupiers. In consequence, a very large part, probably the majority of the houses stand in the names of the occupiers. This custom extends to the so-called common laborer. As would be expected, under these conditions, in normal times rents are comparatively low.

Though overcrowding undoubtedly occurs in certain sections and among certain race stocks, in general it can not be said to obtain for any large section of the population, for according to the United States census of 1910, there were 101,905 dwellings to 118,851 families and a population of 558,485.

PART II.—HISTORICAL DEVELOPMENT OF THE HEALTH DEPARTMENT AND OF HEALTH LAWS AND REGULATIONS IN BALTIMORE AND THE STATE OF MARYLAND.

Chapter III.—Ideas underlying the Public Health Laws of Baltimore.

The early health laws of Baltimore were concerned entirely with prevention of the entrance and spread of certain acute febrile diseases. In seeking to interpret the ideas underlying these laws and their administration, it is necessary to review briefly the knowledge and beliefs which obtained at that time in Europe and in North America concerning the natural history, and especially the modes of dissemination, of the prevalent communicable diseases of the time. In Baltimore and in Maryland, as along the rest of the Atlantic seaboard, in 1797, the diseases of this class most usual, most dreaded, and most written about were malarial and yellow fevers, diarrhœa, dysentery, and small-pox. Of the malarial fevers, the intermittent and remittent, or bilious remittent, were common and very fatal. At least two epidemics of yellow fever had been recently experienced. Small-pox was a constant menace.

Typhus fever, measles, scarlet fever, and influenza are known to have visited the town as occasional epidemics, but had not yet become endemic. Whooping-cough and membranous croup were certainly endemic, but faucial diphtheria was rare. Of the diarrhœal affections, dysentery, cholera morbus, and cholera infantum were prevalent and very fatal. Charles Caldwell, of Philadelphia, writing in 1802, stated that the latter affection was far more common and more fatal in American than in European cities and suggested that it be called Americana pestilentia infantum. Pulmonary tuberculosis was common, as perhaps also was pneumonia. Gonorrhœa and syphilis were well known. Typhoid fever had not yet been differentiated as a distinct disease. Bubonic plague, in typical form at least, had never reached America, and fear of this disease was traditional only. Relapsing fever and the English sweating sickness had never been recognized in Baltimore. There were three deadly and much feared "pestilential" diseases, small-pox, yellow fever, and typhus fever, against the entrance of which quarantine and other protective measures were likely to be invoked.

Many of the physicians of Baltimore Town were men of talent, learning, and keen powers of observation and reasoning, and a goodly proportion of them had been trained in England. They were well acquainted with the great British writers on medicine and some were acquainted with the writings of Hippocrates, Galen, and other ancients and with the continental writers of the sixteenth, seventeenth, and eighteenth centuries. In regard to the natural history of

the diseases at present under consideration, the most important writers who influenced them were Thomas Sydenham, Richard Mead, John Huxham, John Pringle, David Monro, John Lind, John Howard, and Gilbert Blane.

From Sydenham's (13) writings had come down not only his clear-cut descriptions of certain acute infectious diseases, particularly small-pox, measles, scarlet fever, and malaria, but his ideas, partly borrowed from Hippocrates and other ancients and partly his own, in regard to the influence of season, temperature, rainfall, telluric, and other natural conditions on epidemics of disease. The teachings of Sydenham which particularly influenced public-health ideas and practice in Baltimore were those that held first, that the kinds of acute diseases prevalent in any given year were dependent upon the constitutions of the atmosphere and that the different constitutions of the atmosphere and, consequently, the diseases governed by them, tended to run in cycles, and second, that certain diseases were associated with particular periods of the year.

Richard Mead's (14) *A Discourse on the Plague,* dated November 25, 1720, and written in reply to an inquiry on the part of the British Government as to the proper measures to prevent the entrance into and the spread through the country of plague, had a most profound influence upon the English-speaking world. The dreaded plague was at that time raging in Marseilles and, to the consternation of many continental and British physicians and publicists, it was held by the authorities and certain leading physicians of that city to be non-contagious. It was feared that the practical effect of this heterodoxy would be relaxation or even abandonment of the usual methods and activities against the disease, resulting in its general spread over Europe. Mead's recommendations, which were enacted into law on December 8, 1720, superseded the former laws on this subject dating from the time of James I. As is clearly shown from his discussion of the subject and from his later writings, Mead's "recommendations," as they are commonly called, were based upon an intimate knowledge gained by travel in his youth of the quarantine system of the Mediterranean seaports, and particularly that of Venice, where the system was established in 1484. Of more importance than the maritime quarantine features, however, were the measures recommended for the local control of the plague should it gain a foothold in the country. When digested, these resolve themselves into 13 principles of action, which cover, in all essential particulars, present-day procedure and practice employed in attempting to control the contactive diseases.

Pringle (15) treated particularly of the acute diseases that attacked the British army and the conditions under which they arose in the campaigns in Flanders and in Germany in the years 1743 to 1748, inclusive. He laid great stress upon the influence of wetness and dryness and of heat and cold upon the prevalence and severity of the diseases which he classed epidemic. Pleurisy, pneumonia, and rheumatism were common in the spring, and malarial fevers in the spring, summer, and autumn. Dysentery, often accompanied by liver abscess, was prevalent, especially in fixed camps, in the hot, close summer weather. He regarded this disease as contagious and ranked it as among the malignant and pestilential diseases. It is evident from his descriptions of the anatomical lesions that he was dealing with both the croupous (bacillary) and

the severely ulcerative (amœbic) varieties. He held that "hospital fever," which was very prevalent in the crowded hospitals, was identical with jail distemper (typhus), but, from his descriptions of cases, it would appear that under this name were classed many cases of pyæmia and septicæmia in connection with wound infection and dysentery. From the frequent occurrence of swelling of the parotid glands as a complication of malignant hospital fever, it seems likely that typhoid fever was also prevalent. Of particular importance in connection with the development of methods designed to control diseases by rendering their causes inactive through the action of chemical agents were Pringle's exact experiments on the effects of various substances, such as alkalies, gums (as myrrh and camphor), Jesuit's bark and acids, both mineral and vegetable, in preventing and arresting fermentation and putrefaction.

David Monro (16), writing of the diseases met with by the British forces in the campaigns in Germany in 1761 to 1763, dealt with the same affections described by Pringle. His observations, however, on the general hygiene of camps, ships, and hospitals were of great importance and must have exerted a very decided influence. He laid especial stress upon bad water as a cause of disease in soldiers. Next to the unwholesome vapors arising from marshes and corrupt standing water, he held excreta to be the chief causes of diseases in camps. He recommended that in camps every precaution should be taken to remove filth and to provide proper latrines, and regarded the frequent changing of camping grounds as most important. He gave definite and specific rules for the organization and management of military hospitals, particularly in regard to the care and cleanliness of the patients and of the bedding and floors. He condemned overcrowding and urged that provision be made for purification of the air of wards by ventilation and otherwise, that those ill with contagious diseases be put in separate wards, and that proper laundries be provided where bedding and clothes could be thoroughly washed and aired.

John Lind (17, 18), the well-known authority on the diseases of sailors and on the hygiene of ships and hospitals, and for many years physician to the Haslar Naval Hospital, in a series of papers published between 1757 and 1776, added greatly to the knowledge of the natural history of scurvy, jail or ship fever, malarial and yellow fevers, and dysentery and the methods of their prevention. In regard to ship or typhus fever, he pointed out that one ship's crew was frequently infected from another by the transfer of infected men, particularly of newly impressed men from Ireland and Scotland, and by visits of seamen from ship to ship. He recommended that these practices be interdicted and that all impressed men be held under observation for a time and be given baths and clean clothes before being assigned to ships. He laid great stress upon proper cleanliness and ventilation of ships and upon better hospital quarters on shipboard. Lind established the fact that ship fever can spread from the sick to the well over no great distance and that those living in houses near infected persons are in no danger, provided communication be cut off. He observed that in the open air the cause of the disease did not spread over 50 feet, and that the heat of an oven, such as will destroy animal life, effectually destroys "this infection." He found that the burning of brimstone over charcoal, used as a method of disinfecting ships "does not destroy some species of vermin, particularly lice." Lind showed that dysentery often attacked those

who used privies that were used by dysentery patients, that this disease often spread rapidly through a hospital ward after the admission of a dysentery patient, and that the virus seemed to be spread particularly by the clothing, bedding, and utensils of dysentery patients.

The intermittent and remittent malarial fevers he held to be the common autumnal fevers of all hot countries, but perhaps different from yellow fever. To Lind belongs the credit of bringing to general attention the value of a course of Jesuit's bark (cinchona) in preventing malarial fevers, a fact which he stated had been demonstrated early in the century by Kramer, physician to the Imperial army in the campaigns in Hungary (1717-1718) along the marshy Danube, then one of the sickliest countries of Europe, and later by the English in their "factories" on the Guinea Coast. Lind quoted three physicians well acquainted with yellow fever in the island of Jamaica, as holding that yellow fever was not contagious, "contrary to the opinion of the American colonists who constantly apprehend its importation from the West Indies in ships and in goods." Gilbert Blane's studies of the diseases of sailors and of warm climates exerted an influence only second to Lind.

The work of John Howard (19, 20), the philanthropist, emphasized the fact that jails in Great Britain and Ireland were the particular homes and breeding-places of fevers, especially of typhus, and indicated the importance of cleanliness and care in their control. He also brought to the general knowledge of the English-speaking peoples the elaborate quarantine provisions of the Mediterranean ports, with their systems of hospitals and lazarettos. To Howard's influence has been attributed some of the most stringent features of the British quarantine system when it was remodeled just about the time that the early health laws of Baltimore were in the framing.

In regard to water-supplies and sewerage disposal, apparently the only standards were taste and a not very highly developed sense of common decency. It will be recalled that after the fall of Rome, in the fifth century, the European world well-nigh if not entirely lost appreciation of the importance of pure water and of the sanitary disposal of human waste. It is well established that these sanitary practices, dating from at least the time of Ninevah, were carried to the Greek cities by the Phœnicians and later were highly developed by the Romans, who introduced them to France, Germany, and England. At the opening of the nineteenth century, drinking-water was obtained from polluted springs, wells, lakes, and rivers, and the efficient use of sanitary sewers, on any large scale at least, had fallen into desuetude.

The development of public-health administration in Baltimore has been so intimately bound up with the evolution of the conceptions conveyed by the terms of contagion and infection that at this point it is necessary to trace these briefly.

CONTAGION AND INFECTION.

Diseases in general and, later, epidemic diseases in particular, were first ascribed to the will of deities, the actual instruments of whose design or wrath were thought to be evil spirits or specially created poisons. The latter were to be avoided by segregation, by flight, and by charms, and the former were to be placated by penitential sacrifice and worship. It is common knowledge that, in certain countries of Europe where science has not been cultivated and

religious superstition and intolerance have been to but a slight degree overthrown, those ideas are still widely prevalent. In illustration of the tenacity with which these ideas may cling, even in a country notable alike for the strength of religious superstition and ecclesiastical tyranny and for great contributions to science, it may be permissible to recall that, when cholera threatened Scotland in 1853, the Presbytery of Edinburgh addressed the British Government, suggesting the appointment of a period of fasting and repentance with the object of appeasing Divine Providence and so turning away a pestilence with which a sinful people was threatened.

The idea of the invasion of the body by harmful agents from the outside is of very remote origin. In very ancient times, the peoples of the Mediterranean basin, from whom western civilization derives its origin, recognized that of the great mass of diseases there were some, especially those affections that spread as plagues and pestilences and those that were particularly identified with certain places, which had in common a constant symptom—fever. It was thus, no doubt, that all diseases fell naturally into one of two groups, the febrile and the non-febrile. With expanding knowledge, these groups, and the febrile group more especially, were submitted to critical study that led to the recognition of classes distinguished by other qualities. Until very recent years, with few exceptions, the great mass of the diseases which man has sought to avoid and to control belonged to the group of which fever is a prominent symptom. Hence it occurred that, from their beginning, health departments were concerned chiefly with acute febrile diseases, and especially with those that came from without, such as plagues and pestilences, and the spread of which experience showed was directly associated with communications. The febrile diseases indigenous to places and so long regarded as necessary evils received less attention and were apt to be treated with a contempt bred of familiarity or accepted with a feeling of helplessness.

At the period of the framing of the first health laws of Baltimore, a sharp distinction was very generally recognized between those acute febrile diseases either observed to be or believed to be conveyed by direct or indirect contact from the sick to the well and those for which this method of transmission was not in evidence or was at least denied. These conceptions had been gradually developed over a long period of history. The causative agents of the contactive or contagious (*con-tango,* touch) diseases were thought to be emanations carried in some instances by the breath and in others by the secretions or the excretions of the bodies of the sick. These disease-producing materials might be the products of secretions or of poisonous substances derived from the breaking-down (putrefaction) of some elements within the bodies of the sick. These substances were generally held to be specific for each contagious disease; that is, the disease-producing cause emanating from an individual with a particular contagious disease was capable of producing that disease only (the emanations of a small-pox patient could produce small-pox only and not measles or scarlet fever or some other disease). The causative agents for the second class of febrile diseases were thought to have their origin in the decay, fermentation, or putrefaction of dead organic matter, sometimes vegetable, sometimes animal. It was held that in fevers proceeding from putrefaction of organic matter outside of the body, none of the secretions or

excretions of the sick were capable of producing the same disease in others. The atmosphere was held to be the sole carrier of harmful agents of this class, and, as it was vitiated or infected (*inficio*-taint, corrupt, or spoil) with or by them, the term *infectious diseases* was applied to febrile diseases whose causes were believed to be so conveyed.

From time immemorial it had been popularly accepted that the malarial (*mala aria*—bad air) fevers were caused by effluvia arising from the decaying vegetable material of marshes and other stagnant water or of the soil, commonly called marsh effluvia or miasmata (Greek, *μίασμα*—defilement). The distinction between miasmatic and other epidemics was especially emphasized by Lancisi (21) in his *De Noxiis Palidum Effluviis* in 1717. This doctrine was widely accepted and fixed at the beginning of the nineteenth century, and, as is well known, remained in force until recent years.

This sharply cut distinction between the terms *contagious* and *infectious* was not universal, for Lind appears to use these terms as having the same meaning, and Robert Hooper (22), writing in 1803 concerning certain diseases epidemic in London during that year, asserted it as his opinion, "that they are not infectious; that is, they are not communicated from one person to another." At the same time, he attributed these diseases principally to causes existing in the atmosphere, "which having induced certain diseases in the human body, are thereby destroyed, without producing any state of the body capable of engendering particles which again can create disease; so that their action is lost, after having produced their first effects." It will be noted that his conception of causation here agrees with that prevalent at the time for infectious diseases, but that he uses the word *infectious* to convey the idea with which *contagious* was commonly identified. According to common usage, Hooper would have stated that the diseases under discussion were infectious and not contagious. Indeed, Hooper, and Lind, too, in a measure, seem to have anticipated for the word infectious a meaning which much later was very generally attributed to it, namely, the capacity on the part of a disease to pass from one person to another by any means whatever.

Nathaniel Potter (23), in his address before the Medical and Chirurgical Faculty of Maryland in 1817, very clearly brought out these differences between contagious and infectious diseases. He pointed out that the ancient physicians, when they spoke of contagion in connection with fevers, recognized no distinction between persons and places, that the ancients in general used the ephithet *contagion* in connection with almost every fever which could be contracted by being in the place where it prevailed, and that this term was never applied in a personal sense to any general diseases except plague and the eruptive fevers until it was suggested for other fevers by Hieronimus Fracastorius in 1547.[1]

[1] In this connection it is interesting that both Potter and Maclean attributed to Fracastorius the hypothesis of febrile contagion and the fears which it engendered—all those commercial impositions under the several forms of quarantine, pest-houses, lazarettos, and even banishment—which were in their opinion a disgrace to civilized man. In essence, the tale runs that in connection with the conflicting interests at the Council of Trent in 1547, when, because of the dissensions among the members, Fracastorius, in order to advance the interests of his patron and friend, the Pope, declared that a fever which had appeared at Trent was eminently contagious and had a particular attraction for those of noble blood. It was claimed that these assertions of Fracastorius in regard to these two particular attributes of this fever overwhelmed with fear the Spanish bishops and the Emperor's

Fracastorius (24) indeed held that all contagions were divided primarily into three classes: (1) Those carried by contact alone, (2) those carried by contact and by fomes (as examples are cited scabies, phthisis, alopesia, and leprosy), and (3) those which, like phthisis and small-pox, are spread not only by contact and by fomes, but at a distance.

Gradually, the febrile diseases were assigned to one or the other of these two classes, and at the end of the eighteenth century the following diseases were regarded as contagious: venereal diseases, leprosy, the plague or the classical pest, elephantiasis, ophthalmia, small-pox, scarlet fever, measles, whooping-cough, hydrophobia, and mumps. Typhus fever, the dysenteries, malignant sore throat, and pulmonary tuberculosis were included in this class by some and excluded by others. To the diseases of the second class, or the infectious diseases, were assigned first and foremost the malarial fevers attributed to the miasmata arising particularly from decayed vegetable matter, and, according to many, dysenteries and typhus fever. It is of interest that Potter (23), in 1817, excluded ophthalmia, plague, malignant or ulcerated sore throat (diphtheria), and typhus fever from the contagious diseases. Anthrax and glanders were apparently regarded as of little importance in man, and cholera asiatica had not invaded western Europe. When it did, it was regarded as non-contagious by the health officials of Baltimore.

It is to be observed that the causes of disease included in the first class were derived from persons, and therefore capable of being spread only through them and their immediate or intimate contactive environment, such as the air immediately about them, their clothes, bedding, utensils, and the like. As a result of the efforts to control the spread of such diseases, great importance came to be attached to the care of articles in intimate association with the sick and to the purification by dilution or by chemical agents of the air immediately surrounding those sick with or dead of these affections. It would appear that the term *fomes* or *fomites* (fuel or tinder) first applied to the harmful agents themselves and only gradually came to signify materials possessing qualities favorable to receiving and holding the causative agents of diseases of this class. Attempts at control of the spread of diseases of this class were therefore logically directed to the management of persons and their immediate environment. The causes of diseases of the second class, originating, as it was believed, outside of living animal bodies from the breaking down of organic material, with the consequent escape of the poisonous agents into the atmosphere, by which their transmission to the living body was accomplished, were to be combated by interfering with development of their causes and by flight, or by purification of the air, either by ventilation or by chemical agents. Prevention of these diseases was, therefore, to be accomplished mainly by the control of environments favorable to the origin of their causative agents. This could be effected best by measures of general sanitation. They were to be avoided by position, cleaning, draining, and filling. In seeking to prevent a given febrile disease, the first point was to place it in its proper category. Hence, the volum-

delegates and thus contributed to the success of the Pope's party in their efforts to remove the council to the Pope's own city of Bologna. The special point of interest is that to these assertions of Fracastorius, made entirely for political reasons and it is claimed without basis in actual fact, were attributed such far-reaching consequences and practices in hygiene.

inous discussions of the older authors as to whether a given disease was contagious or infectious were not simply academic, but involved decisions of a very practical nature.

It had become very widely accepted that the poisons of the contagious diseases were formed in and by the blood-vessels, and that their chief portal of entry to the body was through the skin, where they were absorbed by the nerves. The poisons of the infectious diseases were supposed to enter through the lungs. Various explanations were offered for the observed fact that the poisons of some of the latter class of febrile diseases were most active at night. The fact that they were *par excellence* air-borne satisfactorily explained the influence of winds upon their spread.

While in Baltimore at least, during this period, the miasmatic or infectious diseases were generally believed to be due to the direct action upon the system of poisonous substances of a chemical nature, arising from putrefaction of dead organic matter, there were those who held that the deleterious action of an atmosphere impregnated with harmful substances of this origin was indirect; that is, that, on account of the presence of these substances in the air, the body was unable to obtain from it materials necessary for life with health. To quote Reese (25):

> "When by being exposed to a noxious atmosphere, or the effluvia arising from putrefaction, whereby the pabulum of life, the air, is rendered impure, or so mingled with gases, that the system does not receive the necessary nutriment from its inhalation, disease is produced; we say the disease is excited by infection. These diseases may be contracted any number of times by the same individual."

According to this doctrine, infected or spoiled air was incapable of furnishing the physiological requirements of the body which the latter is accustomed to receive during respiration; in a peculiar sense, therefore, the air was "spoiled" for its proper usage by the body, and the maladies resulting were deficiency diseases. This conception of an indirect mode of action of the miasmatic poisons in causing the infectious diseases conformed, as well as did the idea of their direct poisoning action, with the theory of the efficacy in disease prevention of the purifying of an "infected" atmosphere by dilution (ventilation) or by chemicals. It also explained equally well the observed fact that patients ill with such diseases often improved rapidly or quickly recovered when removed to a "purer" atmosphere.

An important distinction between the contagious and the infectious (miasmatic) diseases was based upon the observation that one attack of one of the former commonly conferred a permanent immunity against that particular member of the group, whereas an attack of a member of the latter group did not. However, it was acknowledged very generally that prolonged residence in localities where they were prevalent was commonly associated with a tolerance to the causal agents of the infectious or miasmatic diseases. A sharp distinction was recognized between this tolerance and the actual immunity attained against one of the typically contagious diseases.

It was not until long after this time that it became established that for a goodly proportion of the diseases included among the contactive diseases, the victim of one attack does not acquire a lasting immunity, as, for instance, in the venereal diseases. The doctrine held best, of course, for certain acute exan-

thematous or eruptive diseases, such as small-pox, varicella, scarlet fever, and measles.

A very good idea of the degree to which distinctions between contagion and infection had been reached in the United States by 1818 was given in the publication of the learned Dr. Shecut (26), of Charleston, South Carolina. Shecut held that there were two kinds of contagion; first, that which is produced by the healthy action of the vessels, as of the rattlesnake, viper, and spider; and secondly, that which is produced or formed by the secreting arteries under pathological conditions, as in lues, variola, and vaccinia. The contagions, he held, were only generated in living animal bodies and were set free in sweat, saliva, blood, pus, or breath of the diseased. When these contagious products of the diseased body were absorbed in bedding or articles of apparel, they became fomites which were just as capable of reproducing the same specific disease as the secretory or excretory product from which the fomes originated. A fomes, then, was a contagion carried not directly from person to person, but indirectly from the sick to the well through the medium of an absorbent material.

Infections were all generated by the decomposition of putrid vegetable or animal substances or both combined, and, hence, they were the result of the processes of putrefaction of dead bodies only. The contagions were communicable only by contact or touch, with the absorption of the virus.

The refinement to which the distinction between contagions and infections and the classification of these two definite types of disease had been carried at this time are well shown in Shecut's syllabus on page 42 of the distinguishing characteristics of contagions and infections and of the elaborate classification of these diseases into classes, orders, genera, and species.

The theory of the chemical nature of the causal agents of the contagious and infectious diseases continued to be generally accepted until well after the beginning of the last quarter of the nineteenth century. It received the support of the great chemist, Liebig, who, likening these disease processes in the animal body to the fermentations, argued that they were caused by ferments. It was on this account that the term *zymotic* came to be applied to these diseases.

It should not be forgotten, however, that the idea of a contagious principle of a living nature, the *contagium vivum* or *contagium animatum*, is a very old one. The idea that certain diseases may be caused by minute living organisms was entertained by Fracastorius (24). In the last quarter of the seventeenth century, it received support from the discovery of micro-organisms by Kircher (27) (1671) and by Leeuwenhoek (27) (1675). Kircher ascribed to minute form-like forms a casual rôle in bubonic plague. Lange and Hauptmann (27) soon after found similar bodies in the foul lochial discharges of women with epidemic puerperal sepsis, and they held that other diseases, such as measles, small-pox, typhus, and pleurisy, were caused by living contagions. Microscopic parasites were held to be the cause of syphilis by Andry (27) (1701) and of malaria by Lancisi (21) (1717). Plenciz (27) (1762) strongly supported the theory that the epidemic diseases in general were caused by micro-organisms. Later, fungi and kindred organisms were found in the intestines of individuals with cholera and typhoid fever, in the lesions of puerperal

SYLLABUS.

Distinguishing characters of contagions and of infections.

Contagions are to be distinguished from infections.

1. In being the product of living animal bodies.
2. By being a secreted fluid, or other matter, capable of reproducing the same specific disease.
3. In being communicable only by contact, or by the close approach of persons, and by the absorption of the matter, or fomites of contagion.
4. And that under all circumstances of the weather, whether a pure or impure atmosphere, wet or dry, hot or cold, etc.

Infections are to be distinguished from contagions.

1. In being the product of dead organized bodies animal or vegetable, or of both combined.
2. By being *aerial fluids* or gases evolved or disengaged from the foregoing, during their decomposition.
3. And are in general only communicable through the medium of an impure atmosphere; i. e., the atmosphere which supports them.
4. Or, they are the product of an inflammatory constitution of the atmosphere, and hence universal.

Genera, or classification of contagions and infections.

CONTAGIONS.

CLASS I. *Fixed or indolent contagions.*

Order I. Tubercula:
  Genus Elephantiasis.
    Species 1. Framboesia.
    Species 2. Coco-bay.
Order II. Squamæ:
  Genus 1. Lepra.
  Genus 2. Psora, etc.
Order III. Vitia:
  Genus Syphilis:
    Species 1. Chancre.
    Species 2. Sibbens?
    Species 3. Laanda?
Order IV. Spasmi:
  Genus Hydrophobia.
    Species *a*. Rabies.
Order V. Phlegmasiae:
  Genus 1. Urethritis.
  Genus 2. Cynanche.
    Species Cynanche maligna.
  Genus 3. Pertussis.
  Genus 4. Phthisis.
    Species Pulmonalis.
Order VI. Vesiculæ:
  Genus Vaccinia.

CLASS II. *Volatile active contagions.*

Order 1. Pustulæ:
  Genus Variola.
Order II. Vesiculæ:
  Genus Varicella.
Order III. Exanthemata:
  Genus 1. Pestis.
    Species Orientalis.
  Genus 2. Rubeola.

INFECTIONS.

CLASS I. *Simple atmospherical infection, or that which is the effect of an atmosphere charged with simple septic miasma (vegetable effluvia).*

Order I. Intermittentes:
  Genus 1. Quotidiana.
  Genus 2. Tertiana.
  Genus 3. Quartana.
Order II. Remittentes:
  Genus Remittens.
    Variety Remittens biliosa.
Order III. Continuæ:
  Genus 1. Synocha.
    Variety *a*. Synochula.
    Variety *b*. Synochoides.
  Genus 2. Typhus vel. Synochus.
    Species Typhus mitior.

CLASS II. *Compound infection, or that which is the effect of the septic miasma, combined with azotic.*

Continuation of Order III, Class I:
  Genus Typhus.
    Species Typhus endemica, vel Icterodes, vel Pestis, Occidentalis.

CLASS III. *Original and primary infection, or that which is produced by azotic miasma (animal effluvia).*

Continuation of Order III, Class I:
  Genus 1. Typhus.
    Species Gravior vel maligna.
      Variety *a*. Gaol.
      Variety *b*. Ship.
      Variety *c*. Camp or lake fever.
  Genus 2. Dysenteria.

CLASS IV. *General or universal infection, or that produced by inflammatory constitution of the atmosphere without regard to either of the miasmata.*

Order Phlegmasia:
  Genus 1. Catarrhus.
    Species Catarrhus epidemica.
  Genus 2. Typhoid pneumonia.

peritonitis, in favus and aphthous ulcers, and in the disease of the silkworm known as muskadine (Bossi, 1837, and Boehm, 1838). Henle (28, 29) (1840 and 1853) and John K. Mitchell (30) (1849) ably supported the doctrine of the micro-parasitic origin of the acute febrile diseases. Mitchell attributed the "malarious and epidemic fevers" to fungi, rather than to animal parasites, largely because of the wider known distribution of the former. He held that the purely chemical theory, and particularly the ferment theory of Liebig, were totally inadequate to explain the established facts of the natural history of these diseases, especially the immunity that follows recovery from the typically contact diseases.

The startling facts brought out between 1850 and 1880 in the controversy over the causation of fermentation and putrefaction added strength to the germ theory of diseases of this class. In the meantime, the finding by pathological anatomists of bacteria in the blood and in the local lesions in anthrax (Pollender, 1855; Devaine, 1863), and in wound infections (Rindfleisch, 1866; von Recklinghausen, 1871; and by such surgeons as Cheyne, Lister, and Billroth), put the germ theory on a more substantial basis. The work of Pasteur, Koch, and their pupils, in isolating and cultivating bacteria from the lesions of a number of diseases and in reproducing identical affections in lower animals by inoculation with pure cultures; the discovery of the *Spirocheta obermeieri* (spirillum of relapsing fever) in 1873, of the *Plasmodium malariæ* by Laveran in 1880, and other protozoan parasites in the blood, and in various lesions in diseases of the lower animals; and, finally, the studies in general and in specific immunity, established the doctrine on a firm basis by 1890. However, even under an overwhelming mass of evidence, the old ideas died hard.

In rapid succession, bacteria were identified as the cause of not only wound infection in all its forms, including puerperal infection, but of tuberculosis, gonorrhœa, typhoid fever, cholera, diphtheria, pneumonia, bubonic plague, and other important diseases in man and the lower animals. Yeasts and higher fungi were found in relation to the lesions in a variety of affections. The demonstration of spirochaetæ as the causal agents of syphilis, yaws, and infectious jaundice and the discovery that sub-microscopic viruses are concerned with the causation of certain other communicable diseases are triumphs of recent years. With these findings and the experiments made possible thereby came not only deeper knowledge of natural and acquired immunity against various febrile diseases, and the use of new and more exact methods of diagnosis, but various antitoxic and antimicrobic sera and bacterial vaccines for the prevention and treatment of disease. Long before the germ theory had been rehabilitated by the discoveries of the last 30 years of the nineteenth century, it had been established that cholera (1849) and typhoid fever (1859) are commonly spread by polluted drinking-water; the rôle of milk as a vehicle for the causative agents of scarlet fever, diphtheria, typhoid fever, and cholera had been discovered before 1885.

Satisfactory explanations of many of the mysteries of the epidemiology of certain diseases were afforded by the demonstration of the important part played by intermediate hosts, mostly insects, in the spread of certain definite microparasites in man and the lower animals—the cattle tick for that of Texas cattle fever by Theobold Smith and Kilbourne in 1893; the mosquito for that

of the hæmatozoa of birds by Ross in 1898 and of malaria soon afterwards; the tsetse fly for that of nagana in horses by Bruce in 1894; the mosquito for that of yellow fever by Reed, Carrall, Argamonte, and Lazear in 1900; and the rat flea for that of bubonic plague by the Indian Plague Commission in 1907, and the louse for that of typhus fever by Nicolle in 1909. It has further been shown since 1900 that relapsing fever is spread by ticks, bedbugs, lice, fleas, and biting flies, and that Rocky Mountain spotted fever is spread by ticks.

The road to these revolutionary discoveries was made easier by the extraordinary advances in the study of pathological anatomy and experimental pathology during the nineteenth century, which not only established such important diseases as typhoid fever, tuberculosis, syphilis, leprosy, pneumonia, dysentery, puerperal fever, wound infection, and other inflammatory affections upon firm anatomical and physiological bases, and pointed to their parasitic origin, but showed the relation of the parasites to the lesions.

It is a matter of importance in this connection that for the majority of the acute febrile diseases, and among them some of the most dangerous, ranked as contagious by both old and recent authorities—i. e., small-pox, vaccinia, measles, scarlet fever,[1] hydrophobia, influenza, and typhus fever—attempts to discover, in the specific lesions or elsewhere in the body, micro-parasites under conditions satisfying the demands of logic that they act causal rôles have completely failed. The positive evidence that these affections are caused by micro-parasites is no stronger now than in the eighteenth century, but the argument in favor of such etiology has been greatly strengthened by analogy; that is, in their natural history they present features so similar and in some respects so closely identical with those that characterize diseases for which proofs satisfactory to the strictest logical requirements for such causation have been established. For the same reason, also, the argument by exclusion has gained some additional weight.

The discovery that typhus fever is spread by the body-louse not only removed this disease from the class of the typically contagious diseases, but by analogy placed it more definitely in the category with other diseases proved to be caused by micro-parasites transferred from one individual to another by biting insects, for the bites of only those lice that have infested individuals with typhus fever can spread the essential cause of this disease. In the lesions of poliomyelitis, classed among the contagious diseases and known only slightly to former generations, but revived in widespread epidemics in recent years, Flexner and his coworkers have discovered minute bodies which seem to be the etiological factors. In yellow fever, classed among the affections reckoned as effluvial in origin, Noguchi has demonstrated a spirochete, which further observations may prove to be the causal agent.

In their advocacy of the old thesis of *contagia viva* in the causation of the febrile diseases, Henle and Mitchell argued both by analogy and by exclusion, attempting by the former to establish points of similarity between these diseases and certain affections of plants and lower animals in which micro-organisms had been found under conditions suggesting or even proving a causal relation, and seeking by the latter to show that of the various explanations proposed,

[1] Since this was written the recent highly suggestive work of Dick and Dick and others on the causation and the serum reactions of scarlet-fever has been published.

this was the only one consistent with the ascertained facts of the natural history of these diseases. At this time the latter mode of argument was the stronger because it was supported by the heavier weight of facts. With the demonstration in rapid succession that a number of diseases, including examples of those classed as contagious and those classed as miasmatic or effluvial, are due to micro-parasites, the analogical argument in favor of like causation of the remainder was correspondingly strengthened. Facts supporting both these lines of argument have become so overwhelming in recent years that there is no escape from accepting the generalization that all the febrile diseases transmissible in continuous series from one individual to another must be caused by the action of living parasites.

In later chapters a complete list of these diseases, in so far as they have presented themselves in Baltimore, will be given, and the evidence upon which certain of them are held to be transmitted wholely or partly by contact will be submitted to analysis.

Gradually the term *contagion* lost and the term *infection* gained in importance. The former, losing its etiological significance, came to mean only a particular mode of conveyance, namely, by intimate contact. The group of contagious diseases became limited to a particular division of infectious diseases. The terms *infectious* and *infection* gained new and broader meanings. Infectious diseases came to include, for clinicians, the whole group of diseases characterized by fever, increased rapidity of the pulse and respiration, intoxication, with or without local inflammatory lesions; for pathological anatomists the series of degenerations and acute congestions of various organs of the body, notably the heart, liver, kidneys, and spleen, and local inflammatory lesions occurring in febrile affections; for bacteriologists and hygienists, all the diseases proven or thought to be caused by micro-parasites.

For the clinical physician a disease is infectious if it is capable of being transmitted from one individual to another by any means whatsoever; it is contagious if it can be, or usually is, carried by contact with the sick or their immediate environment. The "droplet infection" of Flügge, by which is meant the transmission from one person to another of micro-organisms attached to fine drops of moisture (saliva, mucus, pus) propelled from the mouth and nose in the acts of talking, coughing, and sneezing, belongs under the latter heading. The organisms are thus thrown so short a distance that, in effect, this method of transference may be regarded as so slightly removed from kissing or other forms of actual touch, as to fall well within the conception of "contact." For the clinician, the pathologist, and the bacteriologist, a person or an animal is "infected" after receiving a particular variety of germ in numbers sufficient to cause disease. But, for the bacteriologist "infected" retains its original meaning of "spoiled," "tainted," "corrupted," in the special sense that a germ capable of multiplication comes in contact with a substance of any kind, as nutrient media, an instrument or utensil. It has much the same significance to the surgeon.

Probably the first clear-cut definition of the term *infectious disease* in the modern sense was given by Professor William H. Welch in his lectures at the Johns Hopkins Hospital in the spring of 1890: "An infectious disease is any disease caused by the entrance into and multiplication within the body of

pathogenic micro-organisms." This definition, as Professor Welch pointed out at the time, excludes a large group of affections caused by the invasion of the body by macroscopic parasites of which the worms are examples. For such diseases, there is a tendency to use the term *infestion*. Thus in modern usage, infection has to do with causation alone and omits all consideration of modes of communication, while contagion deals only with a particular mode of transmission, i. e., by contact, and has nothing to do with ultimate causation. Some of the infectious diseases are typically contagious, but many are not. With the adoption of a new meaning for infectious, its synonym, miasmatic, fell into disuse. Fomites, from being the fuel itself carried by the absorbent material, came to signify the material which conveys the fuel, a complete reversal of meaning.

To avoid the great confusion of meanings attending the use of the terms *contagious* and *infectious* as applied to the febrile diseases, especially among the older generation of physicians who could not readily follow the rapid development of the new science of micro-parasitology in which they had had no training (and this group included many health officers), the terms *communicable* and *transmissible* came into use about the beginning of the twentieth century to include the group of affections caused by invasions of the body by vegetable or animal parasites.

The idea that emanations from sewers were efficient causes of diseases naturally followed from the conception that certain epidemic diseases were due to the effluvia arising from the putrefaction of dead organic material. Therefore, the emanations from either open sewers or the traps of closed sewers, or from privies and cesspools were regarded as particularly dangerous. With the development of toilets, wash-basins, and bath-tubs in houses connected with sewers, it was not unnatural that cases of febrile illness developing in these houses were attributed to sewer-gas emanating from the sewers through untrapped or improperly trapped connections. The acute febrile diseases thought to be thus caused were at first either those generally acknowledged to be infectious or miasmatic, such as the malarial-fever group, or those included in this class by some and among the contagious diseases by others, such as dysentery, typhoid fever, typhus fever, and diphtheria. To the latter group the term miasmatic-contagious was often applied. As a result of this conception plumbing construction and plumbing inspection arose to such great importance in health-department administration.

From the foregoing it is clear why, in the first health ordinances, clear-cut distinctions were made between the function of controlling disease through the management of persons and their immediate environment and through the general environment. To the board of health were assigned questions involving personal hygiene and to the city commissioners the control of general sanitation.

Chapter IV.—Evolution of Public Health Laws.

I. Baltimore Town.

II. Baltimore City: The two fundamental ordinances of 1797—*Ordinance No. 11* and subsequent amendments and additions dealing with the organization of the health department and the duties and powers of health officials, the reporting and isolation of cases of communicable diseases within the city, quarantine of the port; Hospitals controlled by the city, and the registration of births and deaths, and of physicians, midwives, and undertakers; *Ordinance No. 15* and subsequent amendments and additions dealing with nuisances, namely, general sanitation on public domains—Street cleaning, garbage, night-soil collection and disposal, food control—Sanitation on private domains—Privies, cesspools, night soil, standing water and decaying materials, cellars, manufactories injurious to health, garbage, habitations, plumbing, foods.

III. State of Maryland: Contagious and infectious diseases; Vaccination; Medical practice; Registration and licensing of midwives; Pharmacists; Nurses, plumbers, undertakers, and barbers; Registration of births and deaths; Lunacy commission; Child and other labor laws; General nuisances; Foods; Building inspection.

I. BALTIMORE TOWN.

The records of public-health activities in Baltimore before the elevation of Baltimore Town into Baltimore City on January 1, 1797, are scanty. During the era of Baltimore Town, the powers of local self-government granted by the legislature were comparatively restricted. There is no record of the existence of anything approaching a separate organized body with duties and powers in connection with public health in the early days of Baltimore Town. Some sort of control over nuisances of the commoner sort was exercised by the town commissioners and by certain special commissioners, as the commissioners for paving streets, for instance. In 1745, an act of the commissioners proscribed the running at large of geese and swine in the town. According to Quinan, the town commissioners passed the following resolution in 1750:

"Whereas, several persons permit stinking fish and dead creatures or carrion to lie on their lots, or in the street near their doors, which are a very offensive nuisance and contrary to Acts of Assembly, the Commissioners, therefore, order the clerk to put up advertisements to inform such persons that they are to remove the same.

"*Resolved,* That Dr. Wm. Lyon be a committee of one to enforce the same."

In 1793, when yellow fever was prevalent in Philadelphia, Governor Lee appointed Dr. John Ross and Dr. John Worthington as quarantine physicians, the former to regulate quarantine by sea and the latter by land. In 1794, Governor Lee appointed Dr. Thomas Drysdale as an additional quarantine physician for Baltimore. On July 8 of that year, Drs. Ross, Worthington, and Drysdale, by orders of the governor, stopped all vessels at the quarantine station established below Whetstone Point. These acts of the governor were carried out under Acts of the Assembly in 1766, 1769, 1777, and 1784, empowering the governor to establish quarantine under threatened invasion of pestilential diseases.

According to Quinan (9) and Griffith (3), a committee on health, consisting of seven members was appointed, probably by the town commissioners, in 1794. Quinan speaks of this health organization in 1794 as the board of health and records that on April 24, 1795, a new board of health was elected, which adopted rules and regulations of quarantine on May 7 and urged the citizens to aid in enforcing them. On May 7, 1795, the legislature passed an act empowering the appointment of a health officer for the port of Baltimore, and on July 29, the board of health imposed a quarantine on all vessels from South America or the West Indies and, on August 16, ordered that no hides be landed from vessels within the town limits.

It would appear that the State quarantine officers acted harmoniously in concert with the newly appointed board of health of Baltimore Town, for Quinan records that on August 15, 1794, Dr. Ross publicly defended the board of health which had been charged with negligence in allowing the admission of cases of yellow fever.

All these activities and measures grew, largely at least, out of the serious yellow-fever epidemics of the time. The details of the quarantine system have not been preserved, but it is probable that they were almost identical with those provisions in the first public-health ordinance of Baltimore City, passed on April 7, 1797. It is probable that the board of health of 1795 continued to function until it was relieved by the new public-health organization provided for in Ordinance 11, 1797.

When Baltimore Town became Baltimore City, on December 31, 1796, its public health organization, therefore, consisted of a board of health of seven members, empowered to pass and enforce quarantine regulations, a health officer of the port, and a small hospital at Hawkins' Point for the reception of cases of "pestilential diseases." Such powers over nuisances and general sanitation as existed had been exercised by the town commissioners.

II. BALTIMORE CITY.

Soon after the organization of the new city government of Baltimore in 1797, two health ordinances were passed, one dealing particularly with the control of diseases through persons and their effects, the other with the control of nuisances and other matters of general sanitation. Upon these two basic ordinances has been modeled practically all of the subsequent local health legislation, much of which has been enacted in the form of supplements. The general principles of these ordinances will be discussed separately. It is to be noted that they are of a broad and general, rather than of a narrow and specific, character.

The opening declaration of general principles of Ordinance 11, 1797, is important and shows that the intent of the authorities was to prevent the origin, introduction, and spread of "pestilential and other infectious diseases." The placing of the powers and duties of the health department under nine commissioners of health was probably done with the intention of having all sections of the city fully and forcibly represented. The hospital at Hawkins' Point had been established some years before as a yellow-fever hospital in connection with the quarantine instituted for that purpose. In the second section of the ordinance are enumerated the various kinds of nuisances which

it was thought important to attempt to control, and under this heading fell all of the items included under the head of general sanitation of that date. It must be regarded as a declaration of the general principles of sanitation. It did not, however, make it the duty of the board of health to prevent or correct such nuisances, this duty being left to the city commissioners as provided in Ordinance 15. Sections 3 to 9, inclusive, and section 11 deal entirely with the quarantine of persons and goods entering by land or sea. The intent of these provisions was to prevent the introduction of *any* "contagious or pestilential disease" from over seas. For this purpose, there was provided a paid quarantine health officer to visit vessels before their near approach to the harbor. Power was granted to remove those ill with contagious diseases to the hospital at quarantine, and communication between quarantined vessels and the city was forbidden. There were, however, no provisions specified for cleaning vessels or disinfecting cargoes at the quarantine station. The landing of damaged hides, damaged coffee, and other damaged goods within 3 miles of the city was interdicted. It will be noted that the quarantine applied to all vessels from over seas and to such vessels as came from suspected places in this country, and that the quarantine period was for only 7 months of the year. Vessels were not to be indiscriminately detained for the usual 40 days, but only long enough to satisfy the quarantine physicians that they were not dangerous. In comparison with the elaborate, strict, and inelastic quarantines of the Mediterranean ports, of England, and of certain American ports, notably New York and Philadelphia, these regulations were mild. In common with the practice at these ports, however, the belief was recognized that damaged goods bore direct relation to the spread of the diseases the introduction of which it was sought to prevent. It would appear that the entry of ordinary goods not subject to putrefaction was not considered dangerous. There is reason to think that the quarantine was chiefly against yellow fever and smallpox and perhaps typhus fever and that the plague, so feared by Europeans and which had never invaded the United States up to this time, was not considered likely to be introduced into Baltimore. This ordinance gives no indication that the city government at that time had any idea of attempting to combat by restrictive measures the spread of any other disease established within the city than the malarial fevers.

Ordinance 15, 1797, which deals practically with those nuisances mentioned in section 2 of Ordinance 11, is to be regarded as complementary to that ordinance, but the powers granted under it were to be exercised by the city commissioners and not by the board of health. This ordinance provided for the cleaning of sidewalks by abutting property owners, and interdicted the placing of household or manufactory refuse upon the public streets and the creation of offensive nuisances of various kinds. It directly aimed at the prevention of the stagnation of water and the decomposition of vegetable and animal matter upon either private lots or public highways, and, finally, it provided for the removal of household refuse and for the cleaning of the streets at the expense of the city.

These two basic health ordinances of the City of Baltimore have undergone many modifications and amplifications in various details in the 123 years since they were written. Considerable changes took place between 1797 and 1824, a period marked by experimentation and shifting of opinion. The

changes in the health ordinances were probably greatly influenced by the development of vaccination against small-pox and by the conclusion reached after much experience and debate that yellow fever is not contagious and not necessarily imported, but of local origin. To avoid confusion and useless repetition, the changes in and additions to these basic ordinances will be presented as concisely as possible under the various subjects which they concern and in the order of their appearance in the field of the health department's activities.

ORDINANCE 11, APPROVED APRIL 7, 1797.

An ordinance to preserve the health of the city, and to prevent the introduction of pestilential and other infectious diseases into the same.

"Whereas it is found necessary in all large cities, particularly those bordering on the seas, to establish such laws and regulations as may tend to preserve the health of the inhabitants. And whereas it is of the utmost importance to the commerce of this State, that the health, welfare and prosperity of this city be preserved, and that the origin, introduction and spreading of pestilential and other infectious diseases, be prevented.

"Therefore be it enacted and ordained by the mayor and city council of Baltimore, that nine persons be appointed commissioners of health, to aid and assist the health officer for the time being, in carrying the provisions of this ordinance into effect, and that the said commissioners shall have the direction and government of the hospital established on Hawkins' Point; shall be authorized, and they are hereby authorized and empowered to establish such rules and regulations for the government of the said hospital, as to them may appear proper and necessary; to contract with a suitable person to superintend the same, and for as many assistant physicians and nurses as circumstances may at any time render necessary; to provide medicine and all other articles which may be necessary for the comfort and accommodation of the sick; to provide for a ready communication between the hospital and Fort Whetstone Point or the city, and to do all other matters and things, which by this or any other ordinance they are or may be required to do.

"Be it enacted and ordained, that all ponds of stagnant water, all cellars and foundations of houses, whose bottoms contain stagnant and putrid water, all dead putrefied animals lying about the docks, streets, lanes, alleys, vacant lots or yards, all privies that have no wells sunk under them, all grave yards, tallow chandleries, tanneries, sugar boilers, skin dressers, dyers, glue boilers, and slaughter houses not properly regulated; all docks whose bottoms are alternately wet and dry by the ebbing and flowing of the tide, all accumulation of filth in the streets, lanes, alleys and gutters thereof, all accumulations of vegetable and animal substances, undergoing a putrefactive fermentation, are hereby declared common nuisances, productive of offensive vapors and noxious exhalations, the causes of diseases, and ought to be restrained, regulated and removed.

"Be it enacted and ordained, in order the more effectually to prevent the introduction of pestilential and other infectious diseases into the city, that at any time when the mayor of the city shall receive satisfactory information of the existence of any pestilential or other fatal disease, in any place on the continent, with which the citizens of Baltimore may have communication or connection, the mayor may and is hereby authorized to issue a proclamation, forbidding the entrance of all persons coming from such infected places into the city or within three miles thereof, and the citizens from having any communication with them, for at least fifteen days; provided he, she, or they cannot produce an approved certificate of their absence from such place for at least fifteen days previous thereto; and every person wittingly and knowingly offending against the directions of the said proclamation shall forfeit and pay one hundred dollars for every such offence, one-half to the informer and the other half for the use of the city.

"Be it enacted and ordained, that the health officer for the time being shall, and he is hereby, directed to visit all vessels coming from beyond the seas, and all other vessels coming from suspected places, in the months of April, May, June, July, August, September, October, and November, and where it shall appear necessary, detain the same at or

below the fort till he hath made two or more visits on board; and if it shall appear to such health officer that a further detention be necessary, he shall oblige the same to perform a quarantine not exceeding twenty days, and in all such cases the health officer shall give a certificate to the captain or master of the vessel, signed with his name, expressing the number of days the said vessel is to ride quarantine, and at or before the end of each quarantine the health officer is hereby enjoined to make a second visit to the said vessel; and should it appear to him that a further quarantine is necessary, he is hereby authorized to enjoin the same for any number of days not exceeding ten.

"Be it enacted and ordained, that if the master or other person having charge of any vessel bound to the port of Baltimore, having on board any person or persons disordered with any contagious disease, or coming from any sickly port or place without a clean bill of health, shall bring his vessel or suffer or permit the same to be brought nearer to the port of Baltimore than Hawkins' Point, or shall land or bring on shore, or cause or suffer to be landed or brought on shore, any such infected persons, or any part or parcel of their goods or effects, or any other goods, until he has obtained a license or permit so to do from the health officer or his assistant, such master or any other person having charge of such vessel shall forfeit and pay for every such offence the sum of one thousand dollars, for the use of the city.

"Be it enacted and ordained, that if any master or other person having command of any vessel at the time of inquiry by the aforesaid health officer or his assistant shall have on board any person infected as aforesaid, and shall knowingly conceal the same, or shall not make a just and true discovery to the said health officer or his assistant of the sickly and disordered state of all and every person on board, from the time the said vessel departed from the port or place from whence she last sailed to the time of said inquiry, and of all other particulars necessary for the said health officer or his assistant to know, respecting the premises, such master, or other person having command of such vessel, shall forfeit and pay for every such offence the sum of three hundred dollars, for the use of the city.

"Be it enacted and ordained, that during the detention of any vessel at or below the fort, by the health officer, or during the time of her being ordered to perform quarantine by him, it shall not be lawful for any person on board such vessel to come on shore and have communication with any person, or for any person to go on board such vessel without the permission of the health officer in writing; every person offending against the provisions of this clause shall forfeit and pay the sum of twenty dollars, to be applied for the use of the city.

"And be it enacted and ordained, that if any pilot shall conduct any vessel above Hawkins' Point, having on board above thirty persons, being passengers or servants (and it is hereby, declared to be the duty of each pilot to make due inquiry thereof) such pilot shall forfeit and pay one hundred dollars for the use of the city, and if any pilot shall have knowledge that there is on board any vessel that he undertakes to pilot, any persons distempered with the plague, or any malignant contagious disease, and it is hereby declared to be his duty to make due inquiry thereof, and shall pilot such vessel above Hawkins' Point, he shall forfeit one hundred dollars for the use of the city; and such pilot shall be disqualified to act as pilot for one year; and if any pilot shall have knowledge that there is on board any vessel that he undertakes to pilot, any person distempered as aforesaid, and it is declared to be his duty to make due inquiry thereof, and shall conceal the same from the aforesaid health officer or his assistant, such pilot shall forfeit one hundred dollars, for the use of the city, and such pilot shall be disqualified to act as pilot for one year.

"And be it enacted and ordained, that the commissioners of health shall watch over the health of the city; and aid and assist the health officer in the discharge of his duty, and carry into effect the provisions of this ordinance, and shall meet at the court house or some other place in the said city, on the first Monday in the months of May, June, July, August, September, October and November, or as often as occasion may require for the purposes aforesaid, collect and receive every possible information of the healthiness of the same; and the health officer is hereby required then and there to meet them, with such evidences of facts relative to his appointment as may have come to his knowledge; and the said commissioners of health shall give all necessary assis-

tance to the health officer in the execution of his duty, cause all persons actually laboring under infectious diseases (and not otherwise provided for) to be removed to the hospital on Hawkins' Point, or elsewhere, distant from the city at least three miles, and provide for the infected such meats, drinks, bedding, and clothing as may be absolutely necessary or ordered by the health officer, and with the advice of the health officer, or other practicing physician or physicians, whom they may consult, may take such further measures in discharging the trust confided to them, as may appear reasonable and proper.

"Be it enacted and ordained, that the health officer or the commissioners of health shall be, and they are hereby, authorized to prevent the landing of any damaged hides, damaged coffee, or other damaged goods from on board any vessel whatever, on any wharf in the city, or within three miles thereof, which in their judgment would endanger the health of the inhabitants. And every person wittingly and knowingly landing any of the same articles, contrary to the provision aforesaid, shall forfeit and pay for every such offence one hundred dollars, half to the informer and the other half for the use of the city.

"Be it enacted and ordained, that the commissioners of health may appoint a clerk, and allow him a reasonable compensation for his services, who shall keep fair minutes of their proceedings, and all necessary expenses incurred by them in the discharge of the duties herein required, which shall be defrayed by the corporation."

ORGANIZATION OF THE HEALTH DEPARTMENT.

COMMISSIONERS OF HEALTH AND PRINCIPAL ASSISTANTS.

The ordinance of March 20, 1801, reduced the number of commissioners of health from 9 to 5, 2 of whom had to come from that part of the city lying east of Jones Falls. The city was divided into five districts, one of which was allotted to each commissioner for supervision. The commissioners were required to meet as a board of health at least once a week in the months of April, May, June, July, August, September, and October for the purpose of communicating and receiving all possible information relative to the health of the city and to advise and consult with each other respecting its preservation.

The number of commissioners of health was reduced to 4 by the ordinance of March 22, 1803, and their authority over nuisances on private domains, including docks, was considerably increased.

According to the ordinance of March 17, 1808, the position of health (quarantine) officer was abolished, and the number of commissioners of health was reduced to 2.

The powers and duties of the city commissioners and the commissioners of health were united by the ordinance of March 22, 1809, and the new commissioners were given the power to execute all the previously passed ordinances regulating the duties and powers of the two commissions. By this act, the control of nuisances and matters of general sanitation were placed under the health department.

In the ordinance of March 25, 1814, it was provided that the number of commissioners be increased from 2 to 3.

By resolution of the city council passed December 4, 1817, the commissioners of health, with other departments of the city government, were required to make annual reports to the council "of the state of the several subjects committed to their charge and to suggest such alterations and amendments, if any, as may be found by experience necessary in the ordinances connected with their different departments."

The ordinance of February 29, 1820, provided for a consulting physician, who with the three commissioners constituted a Board of Health, which was to meet biweekly from March 1 to November 1 and bimonthly from November 1 to March 1. The city was divided into three sanitary districts, each under the supervision of a commissioner, who was required to inspect at least once every two weeks from March 1 to November 1 all the streets, alleys, lanes, wharves, warehouses, cellars, yards, lumber yards, lots, docks, and all other places he might think necessary in his district. Each commissioner was required to report to the board of health on the general state of his district once in every two weeks and to enforce all the laws and ordinances in relation to health, including the abatement of nuisances and the duties in relation to the health department usually performed by the city commissioners, and all others that might be required of him by the board of health or the mayor.

The duties of the consulting physician were to give the mayor and other city authorities such professional advice and information as they required, with a view to the preservation of the public health, to inquire into the health of the city, and when he should hear of the existence of any malignant, pestilential, or contagious disease to investigate such report and ascertain as correctly as possible the causes which produced said disease, to report this information to the board, and to suggest measures to arrest its progress, reporting to the mayor, the board of health, or the commissioners of the districts, as the case required, every circumstance likely to endanger the health of the city.

The salary of the commissioners was $600 each, and that of the consulting physician was $400.

The ordinance of March 1844 abolished the positions of the commissioners of health and of the consulting physician and assigned the duties of the former to the city commissioners and of the latter to the health or quarantine officer.

By the ordinance of May 2, 1845, the health department was again reorganized, this time with one commissioner of health and a city physician, who with the health officer or quarantine physician constituted a board of health to meet biweekly throughout the year with the city physician as presiding officer. The commissioner of health was to attend to all the duties of the health office and was to be present at the office of the board from 9 a. m. to 1 p. m. every day, Sundays excepted. He was to keep a faithful record of all matters relating to the health of the city, to receive all reports from the police officers and others so far as they referred to the duties of the health department, to enforce all ordinances for the preservation of health, and to decide all appeals from the reports of the police officers by a personal examination of the premises in all cases of dispute. It was the duty of the city physician to make a circuit of observation once every week to every part of the city and its environs, in which location or any collateral circumstance might be a cause of disease, and in all cases where he discovered the existence of any morbific agent, the presence of which might prove dangerous to the health of the city, he was to cause any ordinance in existence for its correction to be enforced. If no competent ordinance existed, he was to make a full report to the mayor, accompanied with his opinion concerning the particular action to be taken. It was also his duty to make diligent inquiry into all cases of malignant, infectious, or contagious diseases which might occur and to cause immediate measures to be taken to arrest their progress and generally to notice all things

that related to the preservation of the health of the city. It was the duty of the health officer, in addition to such duties as were required of him by existing ordinances, to attend such meetings of the board of health as he might be requested to attend either by the mayor or by the president of the board, to inform the board of anything demanding the attention of the department, and to advise with the city physician on all subjects particularly "appertaining to the sanitary of the maritime." The police officers were required to execute all orders of the board of health or any member thereof, so far as they referred to the preservation of the health of the city. They were to make daily inspections in their wards and report every morning to the commissioner of health and to enforce all ordinances for the preservation of health within the city. The salary of the commissioner of health was $800 and that of the city physician $400 per annum.

The ordinance of September 4, 1846, retransferred to the board of health all of the duties of the city commissioners.

The ordinance of February 28, 1861, combined the office of city physician and commissioner of health and provided for an assistant commissioner of health, who, with the commissioner of health, would constitute the board of health. The duties of the commissioner of health were unchanged. Those of the assistant commissioner were to keep a faithful record of all reports and other matters of the department, and, in case of sickness or absence of the commissioner or when directed by the mayor, to perform the duties assigned to the commissioner. The duties of the marine hospital or quarantine physician were unchanged.

By the ordinance of May 23, 1882, the health commissioner was authorized to order all post-mortem examinations and to contract with two surgeons to do this work. Later, provision was made for a post-mortem physician and one assistant.

The mayor was made member ex-officio of the board of health, the remaining members being unchanged, according to the ordinance of April 14, 1888. The board of health was required to meet daily throughout the year. The commissioner of health was also made register of vital statistics.

The ordinance of May 7, 1894, empowered the commissioner of health to appoint a chemist and three food inspectors.

By an ordinance of 1896, the commissioner of health was authorized to appoint a bacteriologist and to establish separate chemical and bacteriological laboratories in the health department.

According to a section of the revised charter of Baltimore City of 1900, the health department was made a subdivision of the department of public safety, consisting of the board of fire commissioners, the commissioner of health, the inspector of buildings, the commissioner of street cleaning, and the president of the board of police commissioners, ex-officio. The board of public safety was for consultation and advice and had no power to direct or control the duties or the work of any subdepartment. Section 71 of this charter made the commissioner of health the second sub-department of public safety. The board of health was done away with, and the commissioner of health was given complete charge of the health department, with all of the duties and powers formerly exercised by the board. The commissioner of

health must be a physician of five years' experience and in active practice at the time of his appointment. He may appoint two assistant commissioners of health, a medical examiner, and an assistant medical examiner, and a reasonable number of clerks and subordinates, and fix their compensation.

Since 1900, it has been the practice to establish new positions in the health department through the annual ordinances of estimates, instead of by special ordinances.

VACCINE PHYSICIANS AND HEALTH WARDENS.

By resolution of the city council, December 17, 1821, Drs. Birkhead, Coulter, Allender, Jennings, and Baker were requested to act as a commission to select and appoint a physician for each of the six districts of the city, "whose duty it shall be to obtain a full and exact account of all persons whatever in said districts respectively, who have not been vaccinated or had the small-pox, to vaccinate gratis all persons not competent in their opinion to pay for it, and to use their utmost efforts to induce all others to be immediately vaccinated as a measure loudly called for by the advice of the faculty and by public necessity." The vaccine physicians were required "to keep an exact register of all their vaccinations and the other material occurrences relative thereto, and to report the same as approved by the aforesaid board or commission to the mayor and city council, and to obey all instructions which said board may think proper to give them, or either of them, with a view to effect the full and complete vaccination of every individual within their respective districts." These district physicians received a salary of not over $200 each and in proportion to the nature, extent, and efficiency of their services. These provisions were made at the suggestion of the Medical and Chirurgical Faculty at the time of a severe small-pox epidemic and were temporary.

In 1824, the office of vaccine physician was made permanent, and in this year the commissioners of health were empowered to divide the city into four districts and to appoint for each district a vaccine physician at the salary of $100, "for the purpose of extending the benefits of vaccination to the indigent of our city."

By the ordinance of March 11, 1853, the vaccine physicians became health wardens, and in addition to their former duties they were given the general supervision of the health of their wards. They were to look for and report all nuisances dangerous to health, and "whenever any disease of a contagious character shall manifest itself in their respective districts, they shall, under the direction of the board of health, use such means as the nature of the case may demand to arrest its progress." The ordinance of June 9, 1864, provided for a vaccine physician for each two contiguous wards, who should vaccinate in his wards all such persons pointed out to him by any member of the board of health as susceptible to small-pox contagion and whose duty would be to visit each dwelling-house in his wards and to vaccinate every person presented to him for that purpose. He was also required to keep an office hour to vaccinate all persons calling upon him for such service.

By an ordinance passed October 24, 1882, the commissioner of health was given power to enforce at his discretion the vaccination of all persons not previously vaccinated, residing within the city, and the vaccination of any person in any infected district. Parents and guardians were required to cause

their children to be vaccinated before attaining 1 year of age and revaccinated after 5 years from the last vaccination whenever the commissioner of health should order it. It became the duty of the vaccine physicians or health wardens to effect or oversee the carrying out of these provisions.

Section 71 of the revised charter of Baltimore City of 1900 provided that the commissioner of health shall appoint a vaccine physician for every ward of the City of Baltimore, who shall be a resident of the ward for which he may be appointed, for the purpose of vaccinating all such persons in his ward as may be designated by the commissioner or the assistant commissioner of health as susceptible to small-pox contagion. All of these vaccine physicians shall act as health wardens for their respective wards, generally supervise the health of their wards, and report to the commissioner of health any nuisance which in their opinion is or may become a source of disease, using under the direction of the commissioner of health such means as the nature of the case may demand to arrest its progress.

Inspectors.—By an ordinance of 1797, an inspector was appointed for the examination of salted provisions imported into and exported from the City of Baltimore. The ordinance of October 22, 1883, provided for the appointment of an inspector of plumbing for sanitary purposes to work under the supervision of the board of health. The inspector was to be a practical plumber, skillful and well trained in matters pertaining to the sanitary regulations concerning plumbing work. All plumbing work was to be subject to the supervision of the inspector of plumbing and performed in no other way than in strict conformity to such orders and directions as might be prescribed by the inspector of plumbing with the approval of the board of health.

Four additional sanitary inspectors were provided for the twenty-first and twenty-second wards by the ordinance of June 19, 1888.

Three inspectors of food were to be appointed, according to the ordinance of May 16, 1894, for the purpose of obtaining samples of milk and all other food products, the qualities of which were to be determined by chemical or microscopical examination.

Under Section 68 of the revised city charter of 1900, the commissioner of health was given the power to appoint a reasonable number of sanitary inspectors for the city, not exceeding 15; all inspectors and analysts of bakeries, bakeshops, candy factories, confectioneries, or other places for the manufacture of similar food products, for the purpose of ascertaining their sanitary conditions and cleanliness and the purity, healthfulness, and wholesomeness of the ingredients used in manufacture, and all inspectors and analysts for the proper inspection of milk, or any and all other food products offered for sale in the City of Baltimore.

THE REPORTING AND ISOLATION OF CONTAGIOUS AND INFECTIOUS DISEASES WITHIN THE CITY.

The ordinance of 1797 made no allusion to the reporting of cases of diseases within the city. By the ordinance of March 20, 1801, practising physicians were "invited" to inform the commissioners of health of the state of health of the city and to advise them in all matters relating to the prevention of contagious diseases. The commissioners of health were given full power to remove

any person afflicted with a contagious disease dangerous to the community to a hospital or other place and to prevent any kind of communication with the affected house or family except by physicians, nurses, or persons necessary to carry medicines and provisions. It was made the duty of the commissioners, when a contagious disease was discovered in the city, to advertise the fact and to caution citizens against communication with the infected neighborhood. When such disease threatened to become general, they could advise the inhabitants (of an infected district) to remove to quarters provided for their reception—the poor to be supported at public expense.

The ordinance of February 10, 1820, provided that "it shall be the duty of all and each of the practising physicians in the city of Baltimore, whenever any case of malignant, pestilential, or contagious fever shall happen within the circle of their practice, forthwith to report the same to the mayor or the board of health." The penalty for non-compliance was $100. This section was, however, omitted in a revision of this ordinance 19 days later, on February 29, 1820. One of the sections of this ordinance required that every keeper of a tavern or boarding or lodging-house should report cases of illness, occurring between the first of March and the first of November, in seafaring men or other sojourners, and masters of vessels lying in the harbor were forbidden to remove any sick person therefrom without permission.

In 1821, the board of health was required by ordinance to cause all districts in which yellow fever was confirmed and beyond control to be fenced in and guarded by sentinels.

By the ordinance of April 25, 1834, physicians were requested to report to the board of health within 24 hours all cases of small-pox and varioloid coming to their knowledge, and the commissioners of health were required, whenever they met with a case of small-pox which had not been so reported, to publish in the newspapers the name of the physician who had failed or refused to report it, but in 1838, the threat was omitted. In the code of 1869, even the request to report cases of small-pox was eliminated.

Compulsory reporting of "contagious and infectious" diseases on a limited scale by practising physicians went into effect after the passage of the ordinance of October 24, 1882, which required that "every physician shall report to the commissioner of health, in writing, upon blanks to be furnished by said commissioner, every person having small-pox, cholera, yellow fever, malignant diphtheria, or scarlet fever, and varioloid, and his or her place of dwelling, and name, if known; such report to be made within 24 hours after the first visit, if such report were not previously made by some other physician." By this ordinance, physicians were required also to report to the commissioner of health the deaths of any patients who had died of contagious or infectious diseases, within 24 hours thereafter, with a statement of the specific name and type of disease. The keepers of all hotels and boarding-houses, the agents and owners of all tenement houses or private residences or dwellings, and the commissioners, managers, principals, or other proper person or head officer of every public or private institution in the city were required to report in writing, within 24 hours, to the commissioner of health, the names and ages of each and every one of the inmates of all such houses suffering from any of the above-mentioned diseases. The same rules applied to the masters and agents of vessels not within

quarantine, or within quarantine limits but being within one-fourth of a mile of any dock, wharf, or building of the city. Persons were forbidden to bring to any dock, wharf, or building, or within 1,000 feet thereof, or to have on storage in the city any skins, fish, rags, bones, hides, or similar articles or materials brought from any infected place, except with the written permission of the commissioner of health. The sale of articles of any kind that had been exposed to any contagious disease before they had been adequately cleansed or disinfected and without a written permit from the commissioner of health was forbidden. Without permission from the commissioner of health, no person sick with any contagious disease could be carried from one building to another or from any vessel to the shore. The needless exposure of any individual to those sick with any contagious disease was forbidden. Bodies of all persons dead of any contagious disease were to be buried within 24 hours after death unless this time was extended by the commissioner of health, and no such bodies could be exposed to the peril or prejudice of the life or health of any person. The commissioner of health was instructed to give public notice of infected places by displaying a yellow flag on the premises where infectious diseases existed, and he was given the power to remove any baggage, clothing, bedding, or goods of any character suspected of being infected with any contagious or infectious disease. In every case where there had been small-pox, diphtheria, scarlet fever, or other contagious diseases, and the sick person had either died or been removed from the premises where the disease existed and the occupants had vacated the property without causing a thorough and complete fumigation and disinfection of said property, the owners were required to do this before any person or persons could visit the property with the purpose of becoming tenants or owners.

The use of hackney coaches, buggies, cabs, and gigs for public hire for the removal of persons suffering from small-pox, scarlet fever, diphtheria, or other contagious diseases to or from any point in the City of Baltimore, or of any body dead of such diseases, was forbidden under penalty of having it or them taken by the commissioner of health, disinfected, fumigated, and quarantined for 30 days, unless it or they were used for that purpose only.

The list of diseases reportable by physicians was expanded by the ordinance of May 20, 1890, to include membranous croup, measles, mumps, and whooping-cough. It is strange that both typhus and typhoid fevers were omitted from these lists. The former was surely known at that time to be a " contagious and infectious " disease, and had been so held by the health department since its establishment, as is seen from the reports of the department.

On May 29, 1895, typhoid fever was by ordinance added to the list of reportable diseases. The importance of reporting cases of pulmonary tuberculosis was recognized by the ordinance of May 12, 1896. The commissioner of health was directed to register the name and address, sex, and age of every person suffering from pulmonary tuberculosis, so far as such information could be obtained, and all physicians were requested to forward such information on cards ordinarily employed for the report of cases of contagious diseases, this information to be solely for the use of the commissioner of health. In no case was the commissioner of health to assume any sanitary surveillance of such patients unless the patients resided in tenement houses, boarding-houses, or hotels, or unless the attending physician requested that an inspection of the premises be made.

In no case, unless the patient resided in a tenement house, boarding-house, or hotel, could any inspection be made if the physician requested that no visits be made by inspectors and was willing himself to deliver the circulars of information designed to prevent the communication of the disease to others. This lame ordinance was passed after vigorous effort on the part of the officials of the health department and a few prominent physicians and laymen and against considerable opposition. It gave the health department but little power of control over the individuals affected with this disease and bore all the earmarks of having been written by those opposed to such control.

An ordinance directed against indiscriminate expectoration was passed on February 21, 1905. It contained the following provisions: It shall not be lawful for any person to expectorate or spit in or upon any paved sidewalk or brick path of any public street, avenue, or public square in the city of Baltimore, or in or upon any park or any building under the control of the mayor and city council of Baltimore City, or upon the floor, platform, or steps of any street-railway car, or other vehicle carrying passengers for hire, or upon the floor of any depot or station, or upon the station platform or stairs of any elevated railroad or other common carrier, or upon the floor or steps of any theater, store, factory, or any building which is used in common by the public, or upon the floor of any hall or office, in any hotel or lodging-house which is used in common by the guests thereof. Corporations or persons owning or managing any of the above-mentioned public vehicles or buildings, etc., are required to keep posted permanently and conspicuously in such places notices prohibiting spitting on floors, etc. Sufficient and proper receptacles for expectoration must be provided which shall be cleansed and disinfected once in every 24 hours.

All other diseases now reportable have been made so either by act of the State Legislature, or by resolution of the State board of health, which acts or resolutions apply to the whole State. In 1920, the list of diseases notifiable in Maryland included:

Anthrax (malignant pustule).
Bubonic plague.
Cerebro-spinal meningitis (epidemic).
Chancroid.
Chicken-pox.
Cholera (Asiatic).
Dengue (breakbone fever).
Diphtheria (membranous croup).
Dysentery (acute).
Erysipelas.
German measles.
Glanders (farcy).
Gonorrhœa.
Influenza (grippe).
Leprosy.
Malaria.
Measles.
Mumps.
Ophthalmia neonatorum.
Pellagra.
Pneumonia (lobar).
Pneumonia (broncho).
Poliomyelitis (infantile paralysis).
Rabies (hydrophobia).
Relapsing fever.
Scarlet fever (scarlatina, scarlet rash).
Septic sore throat.
Small-pox (variola, varioloid).
Syphilis.
Trachoma.
Tuberculosis (report on special card).
Typhoid fever.
Typhus fever.
Venereal diseases.
Whooping-cough.
Yellow fever.

QUARANTINE OF THE PORT.

A resolution of the mayor and city council of Baltimore, approved March 19, 1801, instructed the mayor to apply to the United States Government for purchasing suitable warehouses with the requisite wharves and inclosures at

some convenient place near the port of Baltimore where goods and merchandise could be unladen in accordance with the city ordinances.

An ordinance of the same date amplified the quarantine provisions of the original ordinance, the most important section stating:

"And be it enacted and ordained, that all vessels coming from either of the Indies, the coasts of Africa and South America, or any port or place in the Mediterranean, or the seas or waters connected with the same to the eastward of the Straits of Gibraltar, including all and every other port or place on the western side of Spain as far as Cape St. Vincent, from the first of May to the first of November, shall perform a quarantine of 3 days, during which time the health officer shall be compelled to pay them a visit daily, wind and weather permitting, and if at the last visit a further detention be necessary, he shall oblige the same to continue their quarantine, not exceeding 10 days; and in all such cases the health officer shall give a certificate to the master or captain of the vessel, signed with his name, expressing the number of days the said vessel is to ride quarantine; and the health officer is hereby enjoined to pay another visit to the said vessel before the expiration of her quarantine, and if necessary to continue the same any number of days not exceeding 5 days for each quarantine."

Vessels arriving from the West India Islands, or other parts, in the months from June to October, inclusive, and loaded with coffee liable to damage or putrefaction, were not allowed to come into port, but their cargoes were landed and aired or discharged into other vessels while remaining in the river, or in the "bite" within or near Love's Point, except when special permission was granted by the mayor with the approbation of the commissioners of health. All the vessels arriving from the ports or places enumerated in that section of this ordinance previously referred to were to discharge their cargoes and ballast at the quarantine-ground in houses for this purpose, under the inspection of a health officer and representatives of the custom house, before they could be brought to the city. The ship and the wearing apparel of every person on board were to be well cleansed and ventilated before persons could obtain a permit from the health officer to come to the city. Persons sick or in a disordered state on vessels were to be sent to the hospital, or such lazaretto as would be provided for them, and the board of health was empowered to obtain the necessary provisions and other articles for the accommodation of the sick. No disordered person so detained could leave the lazaretto or hospital without the permission of the attending physician in writing. Vessels required to perform quarantine were permitted to send their letter-bags to the post-office by the health officer in such manner as the board of health directed.

The quarantine officer and his assistant were required by the ordinance of March 18, 1807, to be at Fort McHenry every day between 8 a. m. and 6 p. m., if not otherwise engaged in the discharge of their duties. The quarantine officer was required to enter into a book kept for the purpose all marine intelligence obtained from the masters of vessels arriving at the quarantine-ground. This book was to be kept open in his office for the examination of every person. The health officer was required to visit all vessels immediately upon their arrival, wind and weather permitting, coming from beyond the seas or from places where contagious disease was suspected to exist, from the last of April to the first of November of each year.

The ordinance of March 17, 1808, repealed such part of the recently passed health ordinance as required the quarantine of vessels and appointment of a health officer (quarantine physician).

According to the ordinance of May 5, 1809, permission was hereafter to be obtained from the mayor to bring into port vessels loaded with articles liable to damage.

The new health ordinance of February 29, 1820, which was passed after the great yellow-fever epidemic and was drawn up under the influence of the suggestions of the committee of the Medical and Chirurgical Faculty, contained no reference to quarantine.

The ordinance of March 14, 1821, provided that all vessels with passengers from sea voyages should be subject to the orders of the Board of Health which could authorize the landing of persons in perfect health.

According to the ordinance of March 27, 1821, no ballasts could be landed from ships between May and October, until permission was obtained from the Board of Health.

Quarantine was reestablished by the ordinance of March 11, 1823, which provided that all vessels arriving from foreign ports or places and all coasting-vessels should come to the quarantine-grounds until boarded by the health officer, who was required to retain such vessels until he was satisfied that no vegetable substances in a putrid state or other damaged articles were on board. If the conditions of the vessels or cargoes were, in his opinion, such as to endanger the health of the city, he was required to order such airings and cleansings at the lazaretto as he might deem necessary. All vessels found in a safe and clean condition and all coasting-vessels from the eastward of Cape Charles and the vessels from the southward laden with naval stores and lumber only were permitted at the discretion of the health officer to pass up into any part of the basin without restriction, but not within 200 yards of any wharf on the north side of the basin. Here such vessels came under the jurisdiction of the commissioner of health, without whose permission, given after an examination of their cargoes, they could not unload. The commissioner might cause such vessels to be cleaned before coming to any of the wharves or docks of the city. Commissioners of health were not allowed to permit the unloading of any cargo arriving from the West Indies, New Orleans, Florida, South Carolina, Georgia, the Gulf of Mexico, or South America, at any wharf on the north side of the basin or harbor, or on the south side to the eastward of Harbough's Wharf. These quarantine measures were applicable from the first of May to the first of November. One section of this ordinance provided that every public or private armed vessel sailing under commission and every vessel having more than 15 passengers, arriving from sea, were to land their ballasts, empty their water-casks, and cleanse them while at the quarantine or at the lazaretto, so that timber boards could be taken up and the timbers well cleansed and approved by the aforesaid officer before such vessel would be permitted to come to any wharf or dock within the limits of the city. Vessels whose ballasts consisted of salt were exempted from these provisions.

By an ordinance of March 24, 1826, all the better features of the old quarantine laws were reenacted and the whole matter of quarantine was put in charge of the health officer (quarantine physician), under the commissioners of health, who were to decide whether and to what degree quarantine was to be imposed on coastwise vessels and vessels from foreign ports. All such vessels were required to anchor at or near Love Point for inspection by the health officer, who,

after examination of their crews and of the condition of the cargoes and vessels, passed them if he considered them safe. Otherwise, the vessels went to the lazaretto for cleaning, where the cargoes and passengers were discharged. Here, any sick were to be separated from the well. Private armed vessels or vessels having more than 15 passengers were required to submit to the conditions of the previous ordinance applying to them. The lazaretto was lost by fire in 1836.

According to the ordinance of May 27, 1847, the health officer was to inspect all passengers and passenger ships from foreign countries, and whenever, in his opinion, the health of the city might be endangered either from the absolute presence of disease or from an unclean condition of the ship or passengers, he was empowered to require such ship to come to anchor at the quarantine-ground and undergo the usual procedures. It would appear from this ordinance that the quarantine at this time extended only to passenger vessels.

The ordinance of June 18, 1847, made it unlawful to carry from any ship through any street, lane, or alley of the city any person or persons infected with any infectious disease. No material change occurred in the ordinances relating to quarantine until June 20, 1874, when it was provided in the revised ordinances that vessels arriving from points north of Cape Henry, free from epidemical or contagious diseases, and with cargoes from said ports, should not be subject to the usual quarantine regulations, unless in the judgment of the board of health compliance with these stipulations would be necessary to protect the health of the city.

From this date until the quarantine regulations and practices of the country were made uniform and under the general direction and with the cooperation of the United States Marine Hospital Service and its successor, the United States Public Health Service, no material changes were made.

REGISTRATION OF BIRTHS AND DEATHS; DEATH CERTIFICATES; PERMITS FOR BURIAL AND TRANSPORTATION OF DEAD BODIES; REGISTRATION OF PHYSICIANS, MIDWIVES AND UNDERTAKERS.

By ordinance passed October 6, 1874, and effective January 1, 1875, it was required that deaths occurring within the city should be reported to the commissioner of health within 48 hours by the physician in attendance, or in suitable cases by coroners, and that persons practicing midwifery should similarly report each month all births attended by them. In the case of births unattended by a physician or midwife, the duty of reporting, except in the case of births and deaths of illegitimate children, devolved on the father or mother of the child. On death certificates it was required to record the full name of the deceased (and if a minor the name of his father and mother), his color, sex, age, occupation, social state, birthplace, date and cause of death, the ward, street, and number of the residence, and the dates of burial, certification, and registration. These certificates conveyed directly to the health department the information concerning deaths which had hitherto been furnished it through the sextons of cemeteries. This new law also placed interments and disinterments directly under the control of the commissioner of health.

Birth certificates were required to give the full name and the sex and color of the child, the full names of the father and mother, the day, month, and

year of birth, the street and number of house where born, the name and residence of the physician, midwife, or other person signing the certificate, and the date of certification and registration.

To further the carrying out of these provisions, physicians, midwives, undertakers, and sextons of cemeteries were obliged to register their names and residences at the health office. Uniform certificate blanks for deaths and births were supplied by the commissioner of health. They were modified but little until the introduction of the standard certificates of the Bureau of the Census. The original law was amplified, but in relatively minor ways, by amendment in 1884, 1898, and 1904.

ORDINANCE 15, APPROVED APRIL 11, 1797.

An ordinance to prevent and remove nuisances in the city of Baltimore, and within the precincts thereof, and to provide an uniform mode for cleaning the streets, lanes, and alleys within the said city.

"Be it enacted and ordained by the Mayor and City Council of Baltimore, That the inhabitants and occupiers of houses and lots, and sextons, porters or other keepers of churches, meeting-houses or other public buildings, or burying grounds, fronting the paved streets, lanes or alleys within the said city, shall rake and sweep into the cart-way, the dirt, soil, or filth to be found on the brick pavements, foot-ways and gutters before their respective houses, lots, dwellings or public buildings, or cause the same to be done once in every week, that is to say on every Friday, by ten o'clock in the forenoon (when the snow or ice on the same does not prevent) that it may be removed as is hereinafter provided, under the penalty of any sum not exceeding one dollar for every neglect or refusal, for the use of the city.

"And be it enacted and ordained, That no person or persons whomsoever shall cast or lay, or cause to be cast or laid, any oyster shells, shavings, ashes, dirt or stable manure on any of the streets, lanes or alleys of the said city (unless the same be placed or laid in front of his, her or their lot, and removed within two hours) under the penalty of two dollars for every such offence, for the use of the city.

"And be it enacted and ordained, That no person shall cast, place or throw down any rubbish, dirt or materials for building in any public street, lane or alley of the said city, save only in such parts and places as shall be appointed and agreed on by the persons duly authorized therefor under the penalty of one dollar, for the use of the city, for every two hours after notice to remove the same. Provided, that nothing in this ordinance shall be construed to extend to any person or persons employed in building or repairing any house, houses or tenements, so far as shall relate to materials necessarily used in making such building or repairs; but the said person or persons engaged as aforesaid, may use and occupy one-third part in width of any street, lane or alley, clear of the foot-way in front of any lot on which such building is erecting, or repair making, until the same shall be covered in, and twenty days thereafter, and no longer, nor to any person or persons engaged in plastering his, her or their house or houses, but such person or persons shall have a right to use and occupy with plastering, mortar or other materials necessary therefor, one third of any street, lane or alley in front of his, her or their lot or lots, sixty days, and no longer, without the permission of the City Commissioners, under the penalty of one dollar for every two hours, for the use of the city; nor shall the provisions of this ordinance extend to any person or persons dropping fire wood or stone coal at his, her or their door, provided the foot-way be not incommoded therewith, or by the sawing or cutting of said wood; and the said fire wood or stone coal be removed within two days after the same shall be dropped as aforesaid, under the penalty of one dollar for every day thereafter, for the use of the city.

"And be it enacted and ordained, That if any person or persons whomsoever, shall set or place any goods, wares or merchandise, by way of exposing them to sale, on or over the brick or stone pavement, in any public street, lane, or alley in this city, to project more than twelve inches from the wall of his, her or their house or store, every such person shall pay a fine of one dollar, for the use of the city: Provided, that this

clause shall not extend to, or interfere with any regulation in the ordinance concerning the markets, nor extend to goods sold at public auction.

"And be it enacted and ordained, that any person who shall place or pile any empty boxes, barrels, hogsheads or other conveniency, capable of containing goods or merchandise, or that may have contained goods or merchandise, in any part of the streets, lanes or alleys of this city (except as is before excepted) and shall not remove them from the same within four hours after they shall have so been placed or piled there, every such person shall pay a fine of one dollar for every four hours the same shall thereafter be suffered so to remain, for the use of the city.

"And be it enacted and ordained, That if any tanner, currier, distiller, brewer, soap boiler, tallow chandler, hatter, dyer, glue boiler, or any other person within the said city, shall discharge any foul or nauseous liquor, or offal, from any still-house, workshop, or yard, so that such liquor or offal shall pass into or along any of the streets, lanes or alleys of the said city; or if any soap boiler or tallow chandler shall keep, collect or use, or cause to be kept, collected or used in any part of the said city, any stale, putrid or stinking fat, grease or other offensive matter; or if any butcher shall keep at or near his slaughter house, any garbage or filth whatsoever, so as to annoy any neighbor, or any person whomsoever, he, she or they shall forfeit and pay, for every such offence, the sum of five dollars, and shall also forfeit and pay the like sum for every day the same shall be suffered so to remain, for the use of the city.

"And be it enacted and ordained, That if any person or persons having a hog or hogs within their enclosures in sties, shall keep the same in such manner that the stench and filth thereof shall become offensive to, and annoy any neighbor or person whomsoever, the person or persons so keeping his or their hog or hogs as aforesaid, shall forfeit and pay for every such offence, one dollar, and shall also forfeit and pay the like sum for every day the same shall be suffered so to continue, for the use of the city.

"And be it enacted and ordained, That no person or persons whomsoever, shall cast, carry, draw out or suffer to lay any dead horse or other dead carcase, or any excrement or filth from vaults, privies or necessary houses in any part of the said city, precincts or harbor of Baltimore; any person or persons offending herein, shall forfeit and pay five dollars for every such offence, together with the expense of removing the same, for the use of the city.

"And be it enacted and ordained, That the city commissioners shall on the Friday or Saturday of every week, have the dirt and filth found on any of the paved streets, lanes or alleys of the said city, removed therefrom, and deposited in such place or places as may for that purpose be by them provided; which dirt or filth shall afterwards be disposed of in such manner and upon such terms as the said Commissioners shall from time to time direct and appoint: Provided, nevertheless, that the said commissioners may permit any person or persons to collect and carry away the said dirt and filth, or may contract with any person or persons for the removal of the same, or any part thereof, so that the same be removed on the Friday or Saturday of each week as aforesaid, under the penalty of one dollar, for the use of the city, for each and every square of the said city not cleaned as aforesaid.

"And be it enacted and ordained, That every person or persons possessing a lot or lots, which from their low and sunken situations are liable to retain tide or rain water, or on which cellars or foundations for buildings may be dug, and no tenement erected over the same, shall, during the months of June, July, August, September, and October, preserve and keep the said lots, cellars and foundations dry and free from stagnant or putrid waters and other filth; any person or persons offending herein, shall forfeit and pay five dollars, for the use of the city, for every week he, she or they shall suffer such stagnant or putrid water or other filth to remain thereon. And if the said owner or owners shall, notwithstanding the above provision, neglect to remove such stagnant or putrid water or other filth, the city commissioners may employ such person or persons as they may think proper, and upon such terms as to them may seem reasonable and just, to remove from the said lot or lots, cellars or foundations, the said filth or stagnant or putrid water, which said expense shall be considered as a further fine for not complying with the provisions of this clause, and shall be collected accordingly.

"And be it enacted and ordained, That every person or persons possessing a tenement or tenements, warehouse or warehouses on any part or parts of the made ground of

said city, under which a cellar is or may be dug, or vacant space left, shall, during the months of June, July, August, September, and October, keep the same dry and clear of stagnant water, mud or filth, and shall at least once in every week, empty and clear out any stagnant water, mud, or filth from the said cellar or empty space left as aforesaid; any person or persons offending herein, shall forfeit and pay for every offence five dollars, for the use of the city.

"And be it enacted and ordained, That the owner or owners of any cart, wagon, or other carriage, that shall or may be employed in removing or carrying off any of the paved streets, lanes, or alleys of the city, any sand, loam, gravel, earth, dirt, manure, stone, bricks, or coal, shall have and keep the same in such tight and secure condition so that such sand, loam, gravel, earth, dirt, manure, stone, bricks or coal, be not scattered or suffered to fall on any of the streets, lanes or alleys aforesaid, under the penalty of seventy-five cents, for the use of the city.

"And be it enacted and ordained, that if any person or persons shall willfuly and needlessly fire, shoot, or discharge any gun, pistol, or other fire-arms, or make any bonfire, or burn any combustible matter in any of the streets, lanes or alleys of the said City, every such person for every such offense shall forfeit and pay one dollar for the use of the City.

"And whereas, great injury may arise to the citizens of Baltimore from the going at large of hogs, goats, and geese therein:

"Be it enacted and ordained, That the city commissioners shall employ one or more persons to seize and take all hogs, goats, and geese found at large within the said City, and the same to sell and dispose of at public sale, for the use of the City.

"And be it enacted and ordained, That this ordinance shall commence and be in force from and after the first of May ensuing, and continue until the first day of January next, and until the end of the next session of the corporation that shall happen thereafter."

The foregoing ordinance was modified and expanded from time to time by later ordinances.

The character of the modifications and the dates they were made can be most clearly presented under separate activities, all of which, however, fall under two general headings, sanitation on public and on private domains.

SANITATION ON PUBLIC DOMAINS.

Street cleaning.—In 1798, occupiers or owners of houses and lots on paved streets, lanes and alleys were required to clean the gutters in front of them once daily, Sundays excepted, before 10 a. m. The same year the city began to sell street refuse, a practice which was continued for many years. The office of superintendent of street cleaning was created at this time, and in one form or another this office has been continued. Street cleaning, previously under the city commissioners, was transferred to the board of health from 1845 until 1881, when a separate department was established under an independent commissioner. Except for a few years after 1849, when the cleaning of streets was let out to contractors, this work was done by employees of the city.

COLLECTION AND DISPOSAL OF GARBAGE.

In 1821 the superintendent of streets was required to collect garbage on Tuesdays, Thursdays, and Saturdays from May 1 to November 1, and in 1850 watertight and covered carts were provided for garbage and ash removal, and the removal of offal and garbage from the markets was undertaken. In 1877 it was provided by law that all garbage and other like refuse, which heretofore had been deposited on dumps within or near the city limits, should be trans-

ported by rail or water at least 6 miles from the city limits. From 1904 until 1919 garbage so removed was rendered under contract at a point on the bay well beyond the city.

NIGHT-SOIL DISPOSAL.

In 1880, the administrative authorities were granted power to enter into contract to have the night-soil, which heretofore had been deposited on dumps with the garbage, transported by barges to proper places beyond the city. As the laws relating to paving, sewers, and water supplies have to do much more with the inauguration than with the regulation of these services, they are omitted here.

SANITATION ON PRIVATE DOMAINS.

The health officer or the commissioners of health were empowered by the ordinance of February 28, 1798, to order any damaged hides, coffee, or other damaged goods found within the city to be removed therefrom to a distance not exceeding 3 miles. The ordinance of March 20, 1801, gave authority to the commissioner of health to enter all lots, grounds, and buildings on which nuisances of any description might exist, and refusal or neglect to abate nuisances on the order of a commissioner of health was made punishable by a fine of $20. This power was amplified by the ordinance of March 22, 1803, to include cellars and docks. According to the ordinance of February 10, 1820, each commissioner of health was required to inspect, at least once every two weeks between the first day of March and the first day of November, all cellars, yards, lumber-yards, lots, and docks (in addition to streets, lanes, and alleys) within his district and to remove or cause to be removed all nuisances.

PRIVIES, CESSPOOLS, AND NIGHT-SOIL.

The ordinance of February 28, 1798, empowered the commissioners of health to appoint, license, or remove all night-soil men.

By the ordinance of March 18, 1811, it was made unlawful to erect a privy or other building over a wharf or stone wall on Jones Falls, within the limits of the city, which would discharge into the falls except by means of a sewer emptying below the high-water mark.

According to the ordinance of March 18, 1817, no well or hole could be sunk for the purpose of erecting a privy over it or of depositing any odure or other filth therein or of depositing any odure in or upon the surface of the earth (except in privies already erected) in that part of the city bounded on the north by Franklin Street, on the west by North Charles Street, on the south by New Church Street, and on the east by North Calvert Street.

The ordinance of March 9, 1820, required that all dead animals, including fish, and all excrement or filth from vaults and privies, should be so covered with earth on removal as to prevent any noxious effluvia arising from them. It was also unlawful to discharge into any street, lane, or alley of the city any foul or nauseous liquors, or any other offensive matter.

It was provided in the ordinance of March 27, 1820, that the vault or well of every privy which should be erected within certain limits (apparently about a block) on each side of the Eastern Spring and the Western Spring should be

built and floored with sound and well-burned brick, at least 1 foot thick at the bottom and not less than 9 inches thick for the walls, and set in with a cement impervious to water. These vaults were not to exceed 6 feet in depth and were to be well puddled with clay rammed compactly at the bottom and on all sides of every such privy at least 1 foot thick. It was further provided that every privy heretofore or hereafter to be erected, all being within the aforesaid limits, be cleaned out at least once every year, and oftener if required, by the commissioners of health. If the commissioners of health found any privy heretofore erected within the limits described likely to injure or corrupt the waters of the springs, they were to order the owner to clean it out and rebuild it.

Through the ordinance passed in November 1821, it was ordered that all privies kept for private use on docks, wharves, or made ground be made water-tight and sprinkled weekly with lime from the first of May until the first of November. This ordinance further provided that a public privy be constructed on each of the public wharves where it was deemed expedient and in the vicinity of the several market-houses, and that all other privies hereafter to be constructed within the limits of direct taxation were to be made water-tight. No person was permitted to drain a privy to cover its contents, but the contents were to be cleaned out and removed without the limits of the city.

It became the duty of the board of health by the passage of the ordinance of October 26, 1872, to cause inspections of privies to be made between the first and tenth of June by the police, who were required to report those in a state of nuisance which were found full or likely to become full before the first of October. It was further provided that the emptying and removal of the contents of privies should be done between the first of October and the first of June.

The ordinance of November 1, 1873, empowered the board of health to permit any person to clean sinks and privy vaults during the day time, provided the receptacle was air-tight and the work could be done without annoyance to citizens.

The board of health was empowered by the ordinance of June 17, 1886, to clean privies and to abate other nuisances at the expense of the owners, agents, or occupiers, when they had neglected or refused to do so. There was to be no cleaning of privies between the first of June and the first of October unless it was deemed necessary for the health and comfort of the neighborhood.

On October 23, 1891, it was ordained that every well used as a cesspool should be covered with stone not less than 4 inches thick or with iron not less than 1 inch thick, should be at least 6 feet deep, and walled up with brick and stone, and should be well and satisfactorily built. When a well was to be used as a privy, the floor was to be covered its full length and width with the material and thickness as above stated. In all cases such wells and privies were to be water-tight.

The ordinance of February 26, 1906, made it unlawful hereafter to construct any privy well to be used in connection with more than one house.

MEASURES AGAINST STANDING WATER AND DECAYING VEGETABLE MATERIAL ON LOW GROUNDS, WHARVES, AND DOCKS.

It was made unlawful by the ordinance approved March 6, 1820, to fill in the wharves and low grounds, in any part of the city, with any kind of wood,

shavings, or vegetable matter. It was further provided that no spars, arks, logs, or timber, with any bark or sap on them, other than square timber, should remain in the water of the harbor or in any situation within 200 yards of any dwelling or wharf where a common tide could reach them, without the written permission of the board of health. This provision extended from the first of June until the first of November. The throwing of any kind of animal, fruit, or vegetable matter into the basin or dock or into Jones Falls was forbidden during the same period of time.

The ordinance of March 27, 1821, required that owners of all lumber, ship, cooper, and wood yards and saw mills on low or made ground should, at the discretion of the board of health, cover the ground with a sufficiency of fresh earth and lime and from time to time burn their vegetable offals. It was required that all wood-yards for the deposit or sale of firewood be raised above standing water and the wood piled in such a way as to permit the free circulation of air. The board of health was authorized to compel the owner or owners of any vacant lots to keep them clear of nuisances and to grade them so as to prevent any water from remaining upon them.

By this same ordinance the board of health was required to order the cleansing of the heads of docks, sewers, and tunnels, and the deposits of sewers. All wharves where wood was landed were to be scraped as often as the board of health might require in order to prevent the offals of the wood from falling into the docks or basin. This offal, with the deposits from the sewers and the heads of docks, was to be disposed of as manure. This ordinance prohibited the floating of square timber in the water of the harbor.

It was required by the ordinance of November 1821, that not less than 3 feet of water be obtained at the lowest common tide at the docks and wharves of the city between the first of June and the first of October. The board of health was authorized to prohibit all offal and deposits of privies, factories, distilleries, butchers' and other shops, the jail, penitentiary, and other foul premises from being dumped into any of the streams of water or public sewers within the city or in Jones Falls, and all private sewers, carrying other than clean water, from entering these falls. The public sewers were to be cleaned weekly from the first of April until the first of October.

The ordinance of March 8, 1822, repealed that part of the last ordinance which required that the board of health be authorized to prohibit all offal from being deposited in the waters of Jones Falls.

The commissioners of health were empowered by an ordinance approved March 11, 1823, to drain instead of fill up low grounds, when in their opinion draining would answer the intended purpose and where the ground to be drained was not bounded by any street, lane, or alley.

On June 22, 1915, the following ordinance for the prevention of the breeding of mosquitoes was approved:

"1. It shall be unlawful to have, cause, maintain, or permit within the municipality of Baltimore, any collection of standing or flowing water in which mosquitoes breed, or are likely to breed, unless such collection of water is treated so as to effectually prevent such breeding.

"2. The collections of water referred to in section 1 of this ordinance shall be held to be those contained in ditches, gutters, rain gutters or roof gutters, ponds, pools, excavations, holes, depressions, open cesspools, privy vaults, fountains, cisterns, tanks,

shallow wells, barrels, troughs (except horse troughs in frequent use), urns, cans, boxes, bottles, tubs, buckets, or other similar containers.

"3. The methods of treatment of the collections of water specified in section 2 so as to prevent breeding of mosquitoes shall be any one or more of the following:

"(*a*) Screening with wire netting of at least 16 meshes to the inch each way, or any other material which will prevent the ingress or egress of mosquitoes.

"(*b*) Complete emptying every 7 days, or at shorter periods, of unscreened containers.

"(*c*) Using a larvicide approved and applied under the direction of Dr. Henry R. Carter, assistant surgeon general of the United States Public Health Service, or any one deputized by him for that purpose.

"(*d*) Covering completely once every 7 days the surface of the water with kerosene, petroleum, or paraffine oil in sufficient quantities to remain covered at least 12 hours each time.

"(*e*) Cleaning and keeping sufficiently free of vegetable growth and other obstructions, and stocking with mosquito-destroying fish; absence of half-grown or large mosquito larva to be evidence of compliance with this measure.

"(*f*) Filling or draining to the satisfaction of the commissioner of street cleaning of Baltimore City, or any one deputized by him for that purpose.

"(*g*) The removal of tin cans, tin boxes, broken or empty bottles, and similar articles likely to hold water, at least once every 7 days. If not removed they must be so completely destroyed as not to be able to hold water.

"4. Any person who shall violate any provision of this ordinance shall on each conviction be subject to a penalty of not less than one nor more than ten dollars, to be collected as other penalties imposed by ordinance, and the payment of any costs incurred under paragraph 5 hereof."

CELLARS.

The board of health was required by the ordinance of March 27, 1821, to see that all cellars on low or made ground were filled up or otherwise improved at the expense of their owners.

In November 1821, an ordinance was passed requiring that all cellars and other confined surfaces on low or made ground "and where yellow fever is liable to prevail" be filled so as to preserve them as dry as possible; that they be kept clean and well aired and sprinkled from time to time with fresh earth and lime; and that all cellars on made ground be ventilated by properly constructed flues and by leaving a space not filled in, or by raising the floor, or both, so as to admit cleaning them.

It was provided by the ordinance of March 11, 1823, that all cellars and vacancies under stores or warehouses on made ground should, when it was deemed necessary by the board of health, be filled by sound materials and paved with hard bricks or stone; that the lots thereunto appertaining should be filled up above the level of the street; and that all frame buildings below the level of the brick pavement or the street should be raised up and underpinned with brick or stone.

MANUFACTORIES INJURIOUS AND DANGEROUS TO HEALTH.

Since section 6 of Ordinance 15, 1797, certain provisions in regard to these manufactories have been carried for many years in the codes. Some of these provisions date from early times. In general they apply to the manufacture of substances at or during the preparation of which offensive odors are given off, such as the preparation of roofing materials, the manufacture of varnish, the grinding of bones, the distillation of turpentine, the manufacture of soap and

candles, and the manufacture of various acids, bleaching substances, pigments of lead, in the process of which it is necessary to burn horns, blood, bones, etc. All these activities were allowed, but under restrictions, usually not within a certain number of feet of dwellings and by permission.

Under ordinance of April 7, 1871, it was provided that no slaughter or hide house should afterwards be erected within the city limits.

According to the ordinance of May 25, 1893, no persons were henceforth to be allowed to erect or establish within the city limits any poudrette works, glue factories, or establishments for the purpose of rendering grease, dead animals, or animal offal, or stock yards for receiving, feeding, and offering for sale live stock.

GARBAGE.

By the ordinance of November 1821, it was required that household filth of all premises be put out in the streets, lanes, or alleys adjoining, every Tuesday, Thursday, and Saturday of each week, from the first of May to the first of November, before 8 o'clock in the morning, in order that it might be removed by the superintendents of the streets.

Housekeepers were required by the ordinance of April 2, 1853, to place all offal, coal ashes, or dirt which might engender disease, in a box or other vessel convenient of access to the garbage collectors.

The ordinance of June 17, 1886, required householders to provide suitable containers for garbage and offal, and they were forbidden to throw such materials into any street, market, or other public place.

Occupants of dwelling-houses, proprietors of boarding-houses, commission houses, hotels, restaurants, and other places where garbage accumulates, and owners, agents, and occupants of apartment or tenement houses were required by the ordinance of May 20, 1919, to provide a sufficient number of receptacles to contain all garbage which accumulated on the premises during the usual interval between the collections of garbage. These receptacles were to be of metal, water-tight, and provided with a tight-fitting metal cover, with a handle; they were to contain not less than 3 nor more than 10 gallons and be so constructed that the garbage could be easily removed; they were to be easily accessible to the garbage collector; and they were to be kept covered continuously except when being filled or emptied. It was declared unlawful to include with the garbage any ashes, rubbish, or trash. It was further ordained that no dead animal, offal, garbage, or putrescible matter of any sort was to be placed or thrown on any public highway or in any public sewer, and that nothing likely to produce nauseating, vile, or offensive smoke or vapors was to be burned.

HABITATIONS.

The ordinance of June 5, 1871, provided for an inspector of buildings. He was to supervise the construction and repair of city buildings, look after the condition of such private buildings as might be dangerous to persons and property, and control the installation and building of boilers and steam-engines and the placing of sheds, bay windows, telegraph poles, signs, awnings, and frame buildings.

The ordinance of June 4, 1886, regulated dwellings, tenements, and lodging-houses as follows: Every house or building used, occupied, leased, or rented

as a dwelling, tenement, or lodging-house was to have in every sleeping-room which did not communicate directly with the external air a ventilating or transom window with an opening or area of 3 square feet above the door leading into the adjoining room, provided the adjoining room communicated with the external air, and also a ventilating or transom window of the same opening or area communicating with the entry or hall of the house. Where this was impracticable, due to the situation of the room, the latter ventilating or transom window was to communicate with an adjoining room which communicated with the entry or hall. Every such house or building was to have in the roof at the top of the hall an adequate and proper ventilator, of a form approved by the inspector of buildings and the board of health.

The roof of every such house was to be kept in good repair so that it would not leak, and all rain-water was to be so drained therefrom as to prevent its dripping on the ground or causing dampness in the walls, yards, or areas.

These houses were to be provided with good and sufficient privies or water-closets, not less than 1 to every 20 occupants, which could be used in common by occupants of any two or more houses, provided the access was convenient and direct and the number of occupants in the houses did not exceed the above proportion. No privy well was to be allowed in or under or connected with any such house except when unavoidable, in which case it was to be constructed in such a situation and manner as the board of health might direct. In all cases it was to be water-tight and so constructed that no offensive smell or gases could escape. The yard or area was to be so graded that all water from the roof or otherwise could flow freely from all parts of it into the street gutter.

The sleeping or resident portion of any building was to be at least 3 feet of its height and space above the level of the sidewalk or curbstone of any adjacent street. The floors were not to be damp by water from the ground, nor were the rooms to be impregnated or penetrated by any offensive gas, smell, or exhalation prejudicial to health. Overcrowding was forbidden, but no figures were given. Every dwelling, tenement, and lodging house was to be kept clean and free from any accumulation of filth, garbage, and other matter in or on them or in the yards, courts, areas, passages, or alleys connected with or belonging to them. The owner or lessee of any dwelling, tenement, or lodging house was required to cleanse thoroughly all the rooms, passages, stairs, floors, windows, doors, walks, ceilings, and privies to the satisfaction of the board of health, as often as it was deemed necessary, and was to whitewash the walls and ceilings thereof at least once a year.

Secure foundations and construction of buildings were provided for in the ordinance of October 23, 1891, which dealt at length with the thickness of walls and the strength of structure for buildings of various heights and the details of structure in regard to fire prevention.

In 1908, all the previous building laws were repealed and for them was substituted a comprehensive building code, which goes into great detail concerning structure, space, and position of private and public buildings.

This code prescribes that no tenement or apartment houses may be built on any lot facing a street less than 40 feet wide; that there must be a space of from 10 to 25 feet, according to the number of stories, between such houses and other buildings within a block; that they are not to cover more than 80

per cent of a lot bounded by two intersecting streets and must have in the rear, when erected on an interior lot, a yard extending the entire width of the lot; that the height must not exceed the width of the widest street upon which they stand by more than one-half; and that the basement story must not be less than 8 feet in the clear and all other stories not less than 9 feet in the clear. In tenement and apartment houses, every court, entirely inclosed by buildings, onto which windows open from living rooms, is to have minimum dimensions both in area and width, varying from 100 square feet in area and 6 feet in width in two-story buildings to 1,600 square feet in area and 24 feet in width in ten-story buildings. Suitable provisions are made for passages, stairways, and ventilating shafts for toilets, kitchens, pantries, cellars, basements, and the like; for the size of apartments and rooms; and for access to stairways and fire escapes. Every one-family apartment is to contain not less than two rooms, one of which is not to be less than 120 square feet in floor area, and neither of which is to be less than 70 square feet in area. There shall not be less than 400 cubic feet of air-space for every person over 12 years of age and 200 cubic feet of air-space for every child under 12 years of age occupying a room. Every apartment must have a sink with running water and a separate water-closet in a separate apartment within each apartment. On every floor of a tenement or apartment house providing apartments for families, there must not be less than one water-closet for each family. Hallways must be ventilated by skylights in the top story of apartments and by windows. All living rooms, including all rooms except bath-rooms, water-closets, and pantries, are to be lighted and ventilated by windows opening directly into the street, alley, court, or yard. The total area of such windows must equal one-tenth of the floor area of the room, and every room must have at least one window not less than 12 square feet in area, with its top not less than 7 feet 6 inches above the floor. All bath-rooms, water-closets, and pantries must be lighted and ventilated by windows not less than 3 square feet in area and opening directly onto a street, alley, open court, or shaft. These windows are to be so constructed that the top halves of the windows may be entirely opened for the passage of outside air. No paper shall be put on the walls of a room until all former wall paper has been removed and the walls and ceilings thoroughly cleaned. Cellar walls and ceilings must be thoroughly whitewashed or painted a light color at least once a year. Every apartment is to have at least one chimney-flue for stove connections. The alterations, repairs, and changing of other buildings into tenement or apartment houses may only be made under the supervision of the inspector of buildings. Tenement and apartment houses erected prior to the date of this code were ordered to be changed partially or totally to conform with all the provisions concerning tenement or apartment houses.

Provisions in regard to lodging-houses and hotels apply to those erected after the date of the code. These provisions follow very closely those which govern tenement and apartment houses, but they are somewhat more exacting. Every sleeping-room in a hotel or lodging-house must have not less than 700 cubic feet of air-space for every person, every bedroom is to be lighted and ventilated by a window or windows, opening directly upon a street, alley, court, or yard, and at least one window in every such room is to be not less than 12 square feet in area. Every lodging-house which accommodates more than 20 persons

must have one isolation room on the top floor with not less than 1,000 cubic feet of air-space and with a separate sealed off water-closet. Ventilation is to be by means of a skylight, and the walls, roof, and ceiling are to be water-proof. The bath-rooms must have windows of an area not less than one-eighth of the floor area in the isolation room and not less than 3 square feet in the water-closet. These windows must open on a street, alley, or yard.

All buildings must have suitable window areas, and they shall be so placed upon their respective sites and their window construction shall be so arranged that the proper amount of light and ventilation may be secured in all parts and subdivisions of such buildings and for all the purposes of their occupation, all as may be determined by the inspector of buildings.

In two-story houses, the interior room or rooms on the second floor not open to the air and light by direct access to areas or courts are to be provided with skylights, each of an area not less than 5 per cent of the floor area of the room in which the skylight is located and arranged to provide proper ventilation as well as light.

The inspector of buildings must receive applications, examine plans, and grant permits for the erection, construction, alteration, repair, and removal of buildings. He must inspect or cause to be inspected all works of construction, all walls, dangerous buildings, and all buildings, public and private, and all portions and parts thereof. He must determine the application and interpretation of the code and pass upon every question relating to the method of construction or materials used in the erection, repair, or alteration of buildings. For these purposes he may make rules and regulations.

PLUMBING.

The ordinance of October 22, 1883, granted the power to the commissioner of health with the mayor to appoint annually an inspector of plumbing for sanitary purposes, who shall be under the direction and supervision of the board of health. The inspector must be a practical plumber and not interested either directly or indirectly during the holding of his office in the business of plumbing or furnishing plumbing materials. This ordinance provided that no pipe then used or thereafter to be used to drain any matter, liquid or solid, from any building used for habitation or occupancy by man, into any well or sink used for the reception of any substance except pure water, or into any public sewer, or into any stream, or into any harbor, should be put up, constructed, altered, or repaired without first obtaining a permit therefor from the board of health. Construction so authorized could not be undertaken at a date earlier than that named in the application for such permit, and all such plumbing work, as above referred to, was to be done subject to the supervision of the inspector of plumbing and in strict conformity to such orders and directions as might be prescribed by the inspector with the approval of the board of health. Whenever such work was completed in a manner satisfactory to the inspector, he was required to give to the owner or owners of the premises a certificate of inspection and approval.

In 1898, the commissioner of health published a pamphlet of rules and regulations comprising 44 sections, dealing with plumbing and plumbing inspection and based upon the above law. While these regulations for the most part

have to do with the administrative details in the carrying out of the ordinances, they are important from the standpoint of construction in that they give definite instructions regarding the size and laying of pipes, the character of joints, and the like. They make obligatory the use of traps and fresh-air inlets and prescribe their situation. All these provisions conform in general with the accepted usages of that date. They forbade the construction of water-closets in sleeping-rooms, or in any apartment or vault not in direct communication with the outside air by means of a window or air-shaft having an area of at least 4 square feet for the admission of fresh air and light. For water-closets situated outside of buildings, the use of straight non-absorbent hoppers without flush-tanks was permitted. The connection of waste pipes from bath-tubs, wash-stands, and sinks with the trap of a water-closet was forbidden. Except as mentioned, all water-closets were required to have separate flush tanks holding at least 4 gallons of water. The use of long, straight hoppers, or offset hoppers, or pan and plunge closets, was forbidden in any building. Water-closets and urinals could not be connected directly with or flushed from water-supply pipes, but they must be flushed from separate systems on every floor, the water of which is used for no other purpose. Safes and refrigerators are to be drained by special pipes not connected with the house drain or main sewer. Wooden laundry wash trays, or kitchen or other sinks were prohibited inside buildings.

In the building code of 1908, there is a section on plumbing comprising 23 pages. In this code, all plumbing and drainage are placed under the supervision of the commissioner of health, but he is required to furnish the inspector of buildings with a copy of every permit allowing any plumbing work, whether of new installation, alteration, or repair. The inspector of buildings and the commissioner of health must formulate rules and regulations consistent with the ordinances for the execution of plumbing work. This section of the building code includes substantially the points covered by the regulations of the commissioner of health of 1898, but it amplifies them and provides more specifically for the details of construction.

In succeeding ordinances, the powers granted to the commissioners of health in regard to nuisances had expanded so as to cover all forms of nuisances arising from defective surface and roof drainage, the collection of standing water in utensils within and without dwellings and other buildings, and the collection of rubbish, the presence of weeds, grass, cans, bottles, and the like. Orders to abate nuisances have been issued directly by commissioners, inspectors, health wardens, and police officers. Such orders have gone primarily to occupiers of dwellings or buildings, and if not obeyed, to the owners or to their agents.

FOODS.

The ordinances of March 30, 1797, and July 17, 1797, provided that all salt beef, pork, and fish brought into the city be made merchantable, sound, and fit for use, and authorized inspection of these articles.

The clerks of the markets were empowered by the ordinance of March 25, 1805, to prevent the sale of all blown, stuffed, unsound, or unwholesome provisions and to regulate the weighing of them by standard scales.

On May 30, 1855, an ordinance was passed, forbidding, under a penalty of $20 fine, the "adulteration of milk offered for sale or sold in Baltimore by mixing with it water, chaulk, or any drug or other article whatsoever."

In 1879, another ordinance was passed, making it unlawful to mix water, any drug, or other article with milk offered for sale, but, as was the case with the ordinance of 1855, no adequate provision was made by the city government for its enforcement.

By the ordinance of May 16, 1894, amplified by the ordinance of March 19, 1904, it was made unlawful to sell, expose for sale, or to have upon his or her premises, store, stall, stand, vehicle, or elsewhere, from or in which milk or any other food products are sold or delivered, any impure, adulterated, sophisticated, or unwholesome milk or other food products, or any tainted, unsound, rotten, or partly decomposed fish, fruit, vegetables, meat, or any food product that is kept fresh by salicylic or boracic acid or other preservative. It was the duty of the commissioner of health to have inspected milk, meat, fish, and vegetables wherever such articles are sold, kept, or offered for sale in the city and to obtain samples of milk and all other food products whose qualities are to be determined by chemical and microscopical examination and to make the necessary rules and regulations governing these products. Provision was made in the ordinance of 1894 for the appointment of the chemist and three inspectors. According to the milk standards set by this ordinance, there could be sold in Baltimore only pure, unadulterated, unsophisticated milk, the natural product of healthy cows, not deprived of any part of its cream, and to which no additional liquid or solid or preservative had been added, and which at 60° F. would have a specific gravity of not less than 1.029, not less than 12 per cent of total solids, and not less than 3 per cent of butter fat. All milk sold, received, kept, offered for sale, or delivered in the City of Baltimore, could not in any particular be under the standard described, without being considered impure, adulterated, sophisticated, or unwholesome. Nothing in this ordinance was to be construed to prevent the sale of skim milk or buttermilk, provided they be sold as such and in every instance the purchasers be notified of their true character.

The ordinance of April 21, 1896, regulated the ventilation, flooring, and cleanliness of cow stables. The floors were to be of cement or other non-absorbent materials, with grades and channels to carry off drainage connected with the public sewer, if one abutted the premises. The stables for cows for dairy purposes were to have sufficient troughs and boxes for feeding and a covered water-tight receptacle outside of the building for the reception of dung or other refuse. No privy, cesspool, urinal, inhabited rooms, or workshops were to be located within any building or shed used for stabling cows for dairy purposes or for the storage of milk or cream; nor was any fowl, hog, horse, sheep, or goat to be kept in any rooms used for such purposes. The stalls for such cows were to be not less than 4 feet in width. The premises on which cows were to be kept for dairy purposes were to be kept thoroughly clean and in good repair, and well painted and whitewashed at all times. Every cow was to be cleaned and properly fed and watered each day. This ordinance made compulsory the prompt reporting to the health department not only of the occurrence of contagious and infectious diseases among cows, but of cases of Asiatic cholera, croup and diphtheria, measles, scarlatina, small-pox, and typhus and typhoid

fevers upon the premises with milch cows, or where milk is handled or offered for sale. Milk from premises where there were cases of any of these or other infectious diseases could not be sold nor given away until the commissioner of health deemed it safe. Persons connected with dairying and milk handling were forbidden to enter such premises. The tuberculin test for milch cattle within the city was required.

The sanitary conditions under which milch cattle could be kept were made more stringent by the ordinance of May 13, 1902, which required non-absorbent floors in stables, with proper drainage and more air-space and range for cows.

By the changes in the code of 1906, the city government was given extensive powers to control food products.

In 1908, a sweeping ordinance was passed, giving the health department greater control over the milk-supply, requiring permits for handling milk, making provision for dairy-farm inspection, excluding for sale the milk of slop-fed cows, the cleansing of utensils, the regulation of conditions under which milk could be sold, and raising the standard for total solids to 12.5 per cent of butter fat to 3.5 per cent.

The ordinance of June 1, 1917, amended the former milk ordinances so as to give the commissioner of health complete control over the milk and the milk-supply from the farm to the table. To this end it reaffirmed the provision for dairy inspection, permits for shipping milk to the city, and permits for the sale of milk within the city. It also established bacterial standards for raw milk and rules and regulations for the pasteurization, cooling, labeling, and bottling of milk sold within the city and for the cleansing and sterilization of milk cans, bottles, pasteurizing apparatus, and all other utensils connected with the milk industry. All the raw milk sold must come from non-tuberculous cows and must not have a bacterial count of over 50,000 per cubic centimeters. Selected pasteurized milk and selected pasteurized cream must come from tuberculin-tested cows and contain not over 200,000 bacteria per cubic centimeters before pasteurization and not more than 30,000 bacteria per cubic centimeters after pasteurization prior to delivery. Standard milk pasteurized must contain not more than 100,000 bacteria per cubic centimeters after pasteurization and prior to delivery and not more than 1,500,000 per cubic centimeters before pasteurization. "Pasteurized milk shall be milk which has been uniformly heated to a temperature between 140° F. and 150° F. and maintained at that temperature for not less than 30 minutes and cooled immediately to a temperature of 45° or less." Milk and cream falling below the requirements for standard milk pasteurized or standard cream pasteurized are called "below-standard milk" and may be sold only under the authority of the commissioner of health and for only such purposes and in accordance with such restrictions and regulations as may be prescribed by him.

III. STATE OF MARYLAND.

After the passage of the quarantine laws previously alluded to, nearly 100 years elapsed before the passage by the State Legislature of any State laws, with the exception of those establishing the State vaccine institute or agency in 1864, that influenced either directly or indirectly the public-health administration of Baltimore. The law establishing the State Board of Health was passed in 1874.

CONTAGIOUS AND INFECTIOUS DISEASES.

In 1882, the same year in which the city ordinance required the reporting to the commissioner of health by physicians and others of cases of certain communicable diseases, the State Legislature passed a law empowering the health authorities of any city or town or the justice of peace of any county of Maryland, on the certificate of a qualified medical practitioner, to order "the cleansing and disinfecting of any house or part thereof, and any articles therein likely to retain infection," when in their opinion these acts would tend to check or prevent infectious diseases, and where the owner or occupier of such a house was unable to carry out these requirements, the local authorities were empowered to carry out such procedures at the public expense. The law further provided that:

> "Any person who, while suffering from any dangerous infectious disorder, wilfully exposes himself or herself, without any proper precautions against spreading said disorder in any street, public place, shop, inn, or public conveyance, without previously notifying the owner, conductor, or driver that he is so suffering, or being in charge of any person so suffering, so exposes such sufferer, or gives, lends, sells, transmits, or exposes, without previous disinfection, any bedding, clothing, rags, or other things which had been exposed to infection from any such disorder, shall be liable to a penalty not exceeding $500, or imprisonment not exceeding twelve months, or both, in the discretion of the circuit court for the county or criminal court of Baltimore. Any person who carelessly carries children or others infected with infectious diseases or who knowingly introduces infected persons into other person's premises, or permits children under his or her care to attend any school, theater, church or other public place where they will be brought in contact with others, shall be liable to a penalty not exceeding $100 for each and every offence."

Owners or drivers of public conveyances were required to disinfect such conveyances as approved by the local health authority, after conveying in them anyone suffering from any dangerous or infectious disorder or the corpse of anyone who has died from any such disorder. It was forbidden to let for hire any house, room, or part of a house in which any person had suffered from a dangerous or infectious disorder without having it and all articles therein liable to retain infection disinfected to the satisfaction of a qualified medical practitioner. Any health officer or justice of the peace was given the power to cause to be removed or buried at public cost the body of anyone who had died of infectious diseases which was retained in a room in which persons were living or sleeping, or any dead body which was in such a state as to endanger the health of the inmates of a house or room. Notification of cases of infectious diseases was not required by State law until 1898.

By act in 1904, the State Board of Health was required to keep a register of all persons in the State known to be affected with tuberculosis. The superintendent or other person in charge of any hospital, dispensary, school, reformatory, or other institution which derived the whole or any part of its support from the public funds of the State of Maryland, or of any city, town, or county of the State, having in charge or under care or custody any person or persons suffering with pulmonary or laryngeal tuberculosis, was to report that fact to the State Board of Health within 48 hours after the recognition of such disease. Any physician who knew that any person under his professional care was afflicted with pulmonary or laryngeal tuberculosis was required to transmit to the State

Board of Health within 7 days a report of the case on blanks provided by the State Board of Health. The same law provided that apartments occupied by any consumptive were to be disinfected by the board of health of the city, town, or county when they had been vacated by the death or removal of the consumptive occupant. Persons were forbidden to permit anyone, for hire or otherwise, to occupy such apartments before such disinfection. By the same act, persons affected by any disease, the infective agent of which is contained in the sputum, saliva, or other bodily secretion or excretion, who might dispose of the sputum, saliva, or other bodily secretion or excretion in a manner that might cause offence or danger to any person or persons occupying the same room or apartment, house, or part of a house, were to be deemed guilty of a nuisance upon complaint. It was to be the duty of the commissioner of health or of any local health officer receiving such complaint, if the complaint be substantiated, to serve notice upon the person so complained of and to require him to dispose of his sputum, saliva, and other bodily secretion or excretion in such manner as to remove all reasonable cause of offence or danger. It was made the duty of the physician attending any case of pulmonary or laryngeal tuberculosis to provide for the safety of all individuals occupying the same house or apartment, and if no physician be in attendance upon such a patient, this duty should devolve upon the local health authority. The local health authority was required to furnish to physicians reporting any case of pulmonary or laryngeal tuberculosis a printed report, prepared and authorized by the State Board of Health, setting forth the precautions necessary or desirable to be taken on the premises of the said tuberculosis case. If the attending physician were unable or unwilling to take the procedures and precautions specified, these duties then were to devolve upon the local health authority. Physicians who carried out the procedures recommended were to receive on the order of the local board of health a fee of $1.50, to be paid by the State Board of Health. To such physicians an order on the State Board of Health for materials (disinfectants, sputum-cups, etc.) were to be issued for the prevention of the spread of the disease.

By an act of 1894, it was provided that "if at any time within two weeks after the birth of any infant, one or both of its eyes, or the eyelids, be reddened, inflamed, swollen, or discharging pus, the midwife, nurse, or person other than a legally qualified physician, in charge of such infant, shall refrain from the application of any remedy for the same, and shall immediately report such condition to the health commissioner or to some legally qualified physician in the city, county, or town wherein the infant is cared for."

In 1911, the legislature authorized the State Board of Health to provide the "Pasteur antirabic treatment" for the prevention of hydrophobia, free of charge to those unable to pay for it.

VACCINATION.

In 1864, it was required of every practicing physician in the State that he vaccinate all children in the circuit of his practice who might be presented to him for vaccination within one year after birth, if such children be in proper condition for such service, and all other persons, not previously effectually vaccinated, who might request such service from him. There was a penalty of $5 for non-observance of this duty. Physicians were also forbidden under

penalty of not less than $100 nor more than $500 to use any virus defective in its nature by having passed through a scrofulous system, or by having been taken from one laboring under any disease of the skin, chronic sore, or other febrile or other disease, or any crust which, during the progress of the vaccine disease, was punctured or had sustained other injury. Every patient or guardian was required to have his or her child vaccinated within 12 months after its birth, if it was in proper condition, or as soon thereafter as practicable, and any other person under his or her control or care was to be vaccinated prior to November 1 of each year. School-teachers were forbidden to receive into schools, as scholars, persons without the certificate of some regular practising physician that such applicants for admission into the schools have been duly vaccinated. By the legislative act of 1867, the State vaccine agent was required to take all steps necessary to reproduce from the cow true vaccine virus for the use of physicians residing and practising medicine and surgery in the State. He was forbidden to furnish such virus more than four removes from the cow if practicable and none that had not been produced under his own supervision and direction, provided that he might use and furnish virus furnished him by any physician intrusted by him to procure it, such virus not to be taken from the arm of a child less than three months old.

MEDICAL PRACTICE.

The first State act concerning medical practice, which was passed in 1888 and amended in 1892, placed the examinations and medical qualifications in the hands of two separate examining boards; one represented the Medical and Chirurgical Faculty and the other the Maryland State Homeopathic Society.

REGISTRATION AND LICENSES.

By act of the legislature of 1910, all midwives in practice previous to July 1, 1910, were required to register with the local register of vital statistics, and no one was allowed to practice as midwife after this date without license granted after examination by the State Board of Health.

By 1910, the legislature had passed laws regulating the admission into the occupations of pharmacy, nursing, undertaking, plumbing, and barbering.

REGISTRATION OF BIRTHS AND DEATHS.

The first State law requiring the registration of births and deaths was passed in 1898. By this law the Secretary of the State Board of Health was made the registrar of vital statistics and became responsible for the methods and forms of registration and for the tabulation and preservation of the facts. Local health officers of counties, towns, and cities were made local registrars, and physicians became subregistrars and were directed to make returns to the local registrars of births and deaths on suitable forms furnished by the secretary of the State Board of Health. Death certificates of individuals dying without the attendance of physicians were required to be made out by undertakers, coroners, or others having knowledge of them. Midwives were allowed to make returns of births if no physicians were in attendance. Notifications to the local registrar of births and deaths were required of parents, of householders, and of

the superintendents of workhouses, houses of correction, prisons, hospitals, reformatories, almshouses, and other institutions, and by masters or other commanding officers of ships or other vessels. Whereas, under this system, the originals of birth and death certificates were required to be sent to the secretary of the State Board of Health as registrar of the State, this had never been made to apply to the City of Baltimore. With the revision of the registration laws of 1900, it was provided that in the case of births and deaths occurring within the City of Baltimore, the State registrar would not require the return to him of the original certificates of births and deaths, but only such transcripts, tables, figures, and compilations as might seem to him advisable or necessary. Under this provision, the State registrar was to be furnished by the commissioner of health either with duplicates or with punched cards. The enactment of 1904 required that still-born children be registered under both births and deaths, and a certificate of both birth and death was to be filed with the local registrar in the usual form and manner; the certificate of birth to contain in the place for the name of the child the word "still-birth" and the death certificate to enter the cause of death as "still-born." A burial or removal permit of the usual form was required. Under this law, midwives were not to be allowed to sign certificates of death for still-born children.

The State Lunacy Commission, with broad powers, was established by an act of 1886.

CHILD LABOR LAWS.

By an act of legislature of 1888, amended in 1892, the employment of children under 16 years of age in any manufacturing or mercantile business for more than 10 hours a day was forbidden. The law of 1896 forbade the employment of children under 12 years of age in any mill or factory within the State, but this act did not apply to 16 counties of the State, including Baltimore County. According to the act of 1912, as amended in 1914, 1916, 1918, and 1920, children under 14 years of age were not permitted to work in any industry and could not work for hire in any business or service whatsoever during school hours. Boys under 12 and girls under 16 were not allowed to sell newspapers. Children under 16 years of age were entirely excluded from factories in which machines were operated; chemical, paint, and dye works; heavy work in the building trades; manufactories involving the escape of poisonous gases; tobacco factories; work in tunnels and mines; and theatrical and concert-hall appearances. No child under 18 years of age was permitted to work in or about blast furnaces, docks, and wharves, or with electric wiring. They were forbidden to run elevators, to work with dynamos, to oil machinery in motion, or to take part in the operation of polishing or buffing wheels. They could not be employed as railroad hands, trainmen, telegraphers, pilots, firemen, or engineers, or in connection with explosives, in the manufacture of phosphorus matches, or in the manufacture or distribution of alcoholic liquors. No minor could be employed in connection with a barroom.

GENERAL LABOR LAWS.

Between 1904 and 1914, the legislature enacted health laws, governing labor in factories, workshops, and dwellings, and designed to insure adequate sani-

tary surroundings, to guarding against individuals with communicable diseases, and to protect child labor.

By an act in 1896, the proprietors or owners of retail, jobbing, or wholesale stores, or any other place where female help was engaged for the purpose of serving the public in the capacity of clerks or sales ladies were to provide a chair or stool for each one of such female help or clerk.

The legislative enactment of 1884 provided that all factories, manufacturing establishments, or workshops within the State were to be kept in a cleanly condition and free from effluvia arising from any drain, privy, or other nuisance, forbade overcrowding injurious to health of persons employed therein, and required sufficient light and ventilation to render harmless, so far as practicable, all the gases, vapors, dust, or other impurities generated in the course of the manufacturing processes or handicraft carried on therein which might be injurious to health.

By an act of 1894, the manufacture or sale of clothing and other articles in places or under circumstances endangering the public health was forbidden:

"Any room or apartment which shall not contain at least 400 cubic feet of clear floor space for each person habitually laboring in or occupying the same, or wherein the thermometer shall habitually stand, during the hours of labor, at or above 80° F., before the first day of May or after the first day of October of any year, or wherein any person suffering from a contagious, infectious, or otherwise dangerous disease or malady shall sleep, labor, remain, or wherein, if of less superficial area than 500 square feet, any artificial light shall be habitually used between the hours of 8 a.m. and 4 p.m., or from which the debris of manufacture and all other dirt or rubbish shall not be removed at least once in every twenty-four hours, or which shall be pronounced ill-ventilated or otherwise unhealthy by any officer or board having legal authority so to do, shall be deemed a place involving danger to the public health."

By an act of 1896, it was unlawful—

"for any person, agent, owner, or proprietor of a sweatshop or factory where four or more persons are employed, to use coal oil, gasoline or other explosive or inflammable compound for the purpose of lighting or heating in any form; any person, agent, owner or proprietor violating the provisions of this section shall be guilty of a misdemeanor, and on conviction thereof, to be fined by the court before whom such conviction is had, for every violation, the sum of one hundred dollars and costs, and stand committed until such fine and costs be paid.

"The owner or owners of any such house or building used as a sweatshop or factory where four or more persons are employed as garment workers, on other than the first floor of such house or building, shall provide fire escapes for the same; and if any owner or owners of any house or building so used fail to make or provide a fire escape within six months after the passage of this act, upon conviction thereof shall pay a fine of two hundred dollars, to be recovered as other fines in this State, or imprisonment in the city jail for sixty days, or both fine and imprisonment, in the discretion of the court."

An act of legislature in 1910 required the proprietors and managers of shirt factories in the State of Maryland to sprinkle the floors every morning with water.

NUISANCES.

An act of 1886 gave the State Board of Health control over nuisances affecting the water-supply of any city, town, or village. A similar act in 1888 made it unlawful to pollute the ponds or streams used for obtaining ice, and forbade the dumping from ships, scows, steamboats, and other vessels of any ballast,

ashes, filth, earth, soil, oysters, or oyster shells in the Chesapeake Bay above Sandy Point or in the waters of Herring Bay or in any river, creek, or harbor within the State below high-water mark.

FOOD.

The legislature in 1890 passed a broad act directed against the coloring, staining, adulteration, or other sophistication of any article of food or drink, mislabeling, and misbranding, and charged the State Board of Health with enforcing the same, and at the same time gave it power over the inspection and examination of all animal and vegetable food-stuffs, including milk.

INSPECTION.

The Live Stock Sanitary Board, established by an act of the legislature in 1888, was given oversight of contagious and infectious diseases in animals and control over dairymen and others supplying milk to cities, and established sanitary rules in regard to stables for cattle and buildings in which milk is kept or sold.

These powers and duties were extended by the act of 1916, by which the whole matter was placed under the State Board of Agriculture, with greatly increased powers and duties in regard to the inspection of dairies and dairy cattle, milk, creameries, cattle, and meat.

By an act of the legislature in 1880, amended in 1888, inspection was provided for the safety of buildings used for amusement, worship, and lodging in the cities of the State.

PART III.—PUBLIC HEALTH ADMINISTRATION OF BALTIMORE.

Chapter V.—Public Health Measures without the City.

Development of quarantine laws and practices; The lazaretto and quarantine hospitals of the Port of Baltimore: Effectiveness of maritime quarantine.

THE DEVELOPMENT OF QUARANTINE LAWS AND PRACTICES.

In Baltimore the fight concerning the quarantine restrictions to be imposed on the port centered about the question of yellow fever. Concerning small-pox and probably typhus fever there was no controversy. Was yellow fever contagious or non-contagious; was it imported or of local origin? Upon the decision of these questions depended the quarantine policies and the mercantile interests of the young city. The fight over these questions lasted until 1825. The Philadelphia, New York, and Boston ports held to the official British doctrine that the disease was contagious and was imported. These cities, Philadelphia in particular, developed stringent quarantine laws against this disease. In Charleston, the southern port of greatest importance, it would seem that the contrary view was held, for the celebrated Dr. Ramsey (31), of Charleston, in a letter to Dr. Miller, of New York, under date of November 18, 1800, stated that—

"Disputes about the origin of yellow fever, which have agitated the Northern States, have never existed in Charleston; there is but one opinion among the physicians and inhabitants, and that is that the disease was neither imported nor contagious. It was the unanimous sentiment of the medical society, who, in pursuance of it, gave their opinion to the Government last summer, that the rigid enforcement of the quarantine laws was by no means necessary on account of the yellow fever. . . . . My private opinion is that the yellow fever is a local disease, originating in the air of Charleston."

At the time of the outbreak of the great yellow-fever epidemic in Philadelphia in 1793, it was not questioned by any authority, north of Charleston, South Carolina, at least, that the disease was imported and not of local origin. Deveze (32), the resident physician of the yellow fever hospital of Philadelphia, published a paper in December of that year in which he laid down the doctrine that yellow fever is not contagious, but this apparently attracted no attention. Deveze came to Philadelphia from the West Indies, shortly before or during the time of the yellow-fever epidemic, and as we have already learned through Lind, some physicians at least in the West Indies denied that this disease is carried by contact. Dr. Benjamin Rush, with the rest of the leading physicians of Philadelphia, then believed the disease to be imported and spread by personal contact. As we have already seen, the governor of Maryland instituted as vigorous a quarantine as he could against Philadelphia at that time, and this quaran-

tine was maintained not only by the governor but by the local authorities of Baltimore each succeeding year until 1797. Dr. John B. Davidge, of Baltimore, is commonly given the credit for the first printed enunciation in the United States that yellow fever is not contagious. This statement was first printed in the Federal Gazette of Baltimore on November 30, 1797, nearly eight months after the passage of the first health ordinance of the City of Baltimore. In 1798, Dr. Davidge (33), published *A Treatise on the Autumnal Endemical Epidemick of Tropical Climates, Vulgarly Called the Yellow Fever,* in which he defined the disease as follows:

"The yellow fever, synonymous with la maladie de Siam, or la fevre matelotte of the French and vomito prieto of the Spaniards, is the majority or acme, as the intermittent is the embryo, of the remittent bilious fever; it is to the common bilious what the confluent is to the common mild smallpox; they are in kind the same; a specific difference only exists between them. It is conceived in the same matrix and quickened by the same sun, it is indigenous to America and to all other warm climates, it is the very outlet to Americans and Britons, from life to the grave."

Davidge suggested that as the malarial fevers, including yellow fever, are admittedly caused by marsh effluvia, and as the latter appear to be decomposition products of both vegetables or of water, and, in the decomposition of either, hydrogen is produced in considerable quantities, and as this is what occurs in the conditions under which marsh effluvia are generated, the hydrogen set free in this decomposition is the "peccant agent." At that time and for years previous, intermittent, remittent, and bilious fevers and dysentery commonly prevailed in the summer and autumn at Fell's Point and to a certain extent along the low grounds contiguous to Jones Falls and the basin. Fell's Point, however, was always the place of the greatest intensity of these fevers, and it was at Fell's Point that yellow fever always started. Alluding to the yellow-fever epidemic in Baltimore in 1797, Dr. Davidge, who was a member of the committee on health sent to Fell's Point to investigate the disease, stated that the common bilious fever prevailed there as usual from June and that a little later "the disease raised from the grade of bilious to yellow fever and mounted its chariot of death and drove furiously through the streets." He held, therefore, that the malarial fevers, particularly bilious remittent fever, and yellow-fever were one and the same disease, due to the same cause, the effluvia of the decayed vegetable material, and of local origin. He did not deny that either of these diseases could be imported, but he did assert that yellow fever, when it occurred in Baltimore, was not imported. He held that just as the bilious fevers were caused by decayed vegetable material and were not contagious, and as contagious diseases were due solely to human effluvia, so diseases caused by effluvia of decayed vegetable material are *endemic* and are the antitheses of the contagious diseases.

During the yellow-fever epidemic in Rhode Island in 1797, Dr. William Senter (34), the leading physician of Newport, and a member of a committee of physicians appointed to advise the authorities concerning the nature and prevention of this disease, contended that yellow fever was not contagious and was of local origin and not imported. His views were, however, strenuously opposed by his colleagues.

Nathaniel Potter, in the preface of his *Memoir on Contagion* (23), published in 1817, while giving full credit to Davidge for being first to announce in print

that yellow fever was indigenous and was not contagious, stated that he, himself, reached these conclusions in the summer of 1793, while practicing in Caroline County, Maryland, and quoted from a letter which he wrote to Dr. Benjamin Rush, of Philadelphia, his preceptor, saying—

"that these various forms of bilious fever unquestionably owe their existence to the putrefaction of matters on the surface of the earth after an uncommonly wet spring followed by the driest and hottest summer that can be remembered by the oldest inhabitants. With all possible deference to your superior judgment, I can not prevail upon myself to believe that any fever arising from vegetable decomposition is contagious. The origin I have assigned to the epidemic of your city is the only one that is physically possible, and, therefore, you place your adversaries on equal ground with you by acknowledging the fever contagious. Deny the existence of contagion as unphilosophical, and you cut them off from every source. If we admit one of the fevers from marsh effluvia to be contagious we are bound (a priori) to admit them all to be so, intermittent and dysenteric."

Potter further stated that when Dr. Rush was writing in April 1794, on the epidemic of the preceding year, he proposed to Potter to introduce into his work that part of the above letter which described the symptoms and treatment of the epidemic in Caroline County. To this Potter consented, provided Rush would also print the sentiments expressed, so far as they regarded contagion. Rush declined to do this, says Potter, on account of his former belief "that all diseases arising from marsh miasmata were contagious in a degree proportionate to their malignity and that the opposite doctrine was untenable." Believing that he was the only person in America who denied the contagion of yellow fever and deeply impressed that this opinion could be sustained by the facts, in the summer of 1795 Potter selected this topic for his inaugural thesis at the next commencement. He was dissuaded from this, however, by Dr. Wistar, who entreated him on the score of policy and expediency to select some other subject.

In regard to the history of yellow fever in this country and the question as to its contagious character, one of the most important contributions was that of Stubbins Ffirth (35). He held that the experiences of New York, Baltimore, and Philadelphia in the recent yellow-fever epidemics had shown that yellow or malignant fever is not taken from the sick by physicians, nurses, and other attendants. He mentioned instances in which persons, including himself, had slept in the beds of yellow-fever patients without contracting the disease. In his experiments on cats and dogs he was unable to reproduce the disease by feeding black vomit to them. Black vomit introduced into the wounds on the backs of dogs produced no ill effects, and in experiments on himself, including the inoculation of black vomit into his eye, into wounds on his arm, drinking it repeatedly in two successive epidemics, inoculation of himself on or under the skin with the blood serum, the saliva, the perspiration, and the urine of yellow-fever patients in the height of the disease, and finally drinking considerable quantities of the blood serum of yellow-fever patients, the disease was not produced. As all of these experiments, both on animals and on himself, were negative, he concluded that yellow fever is not a contagious disease.

Davidge's publication of 1798 had no immediate effect on modifying the quarantine regulations of the first health ordinance. Indeed, in 1801 and in 1807, they were made more specific and comprehensive by amendments. In 1808, however, the quarantine laws were entirely repealed.

Meanwhile, Potter's notable address on contagion had been published in 1817, and the severe yellow-fever epidemic of 1819 had been experienced and fully written up by Dr. David M. Reese (25), and others (36). In his address of 1817, from which quotations have already been made, Potter reviewed in elaborate manner the history of the ideas concerning contagion and infection, the development of quarantine systems in general, the quarantine regulations of New York and Philadelphia in particular, and the British quarantine system. He concluded not only that yellow fever was not contagious and was of local origin, but he held up the whole quarantine system as practiced in his day to the severest ridicule.

In regard to plague, Potter held that the idea that this disease is carried by simple contact is refuted by experience and by the natural history of the disease. He held that at any rate, so far as quarantine is concerned, it was of little or no importance in America, for in the form described by foreign writers it had never been seen on our continent, although our commercial intercourse had extended to all the countries which had generated it. He affirmed that the quarantine laws of no nation had ever arrested the progress of any disease except small-pox, and even despotic military discipline had failed to check the progress of the plague.

On the question of quarantine against yellow fever, Potter found himself in agreement with President Jefferson, concerning whose position he said:

> "From the commencement of the late pestilential plague in the United States, Mr. Jefferson manifested a lively interest and instituted analytical investigation of the origin of yellow fever. After an elaborate research, he declared the disease not contagious and therefore not imported. In his communication to Congress in 1804, on the state of the Union, he marks an era in the history of our country as the first public functionary in the world who dared to think for himself on this momentous subject."

Potter deeply resented the inclusion by the British government of yellow fever among the contagious diseases to be quarantined on the advice of medical men unacquainted with the disease. His position in regard to yellow fever was further supported not only by his own observations and the experiments of Ffirth, but by his confirming in experiments on himself the negative results obtained by Ffirth. The extensive investigations in regard to the etiology of yellow fever carried out in Baltimore during the epidemic of 1819, as reported by Reese and as recorded in the collection of *Extracts from a Series of Letters and other Documents, Relating to the Late Epidemic or Yellow Fever* (36), confirmed the opinion so forcibly expressed by Davidge and by Potter that yellow fever in Baltimore was of local origin and not a contagious disease.

It is to be emphasized that the views in regard to the nature of the cause of yellow fever were based not upon the opinions of any one man, but upon the observations of a number of keen observers and close reasoners among the medical profession of Baltimore. There had been ample opportunities for these observations, for yellow fever was present in the city in distinctly recognized epidemics in 1794, 1797, 1798, 1799, 1800, 1802, 1819, and 1821. It was also probably present in some at least of the intervening years and almost certainly in 1807. During this time there is but one recorded observation of the introduction of a case of yellow fever from the outside. This case was recorded by Davidge (33), as occurring in August 1797, in a lady who had recently come from Philadelphia, "who brought with her the seeds of the disease," and who

was severely attacked with the disease while walking on Charles Street. She had the genuine black vomit for two nights and a day. No person in her family or in her neighborhood developed the disease. It was acknowledged by Reese that in 1819 a few cases occurred on ships anchored off Fell's Point, but it was claimed that those people had been ashore, and it was denied that they had the disease when the ships arrived.

Yellow fever almost invariably began at Fell's Point, usually at or near the particular locality of Smith's Dock. The docks or slips between the wharves at Fell's Point were described as being filthy, containing a large amount of decaying vegetable material which only moved out under the influence of strong northwest winds. Just east of Fell's Point there were large ponds filled with stagnant water, and this part of the city is described as being ill paved, with numerous collections of stagnant water, and abounding in every other variety of nuisance. It was claimed by Potter (23), that no case of yellow fever ever originated in West Baltimore above Hanover Street, beyond the sphere of exhalation from the docks, wharves, and low grounds. The winds exerted a definite influence upon the progress of the spread of the disease, it being recorded by Davidge and Potter that in the epidemic of 1797, following a strong east wind (northeast according to Davidge and southwest according to Potter), the disease spread rapidly among the inhabitants of the upper part of Frederick, Gay, South, and Calvert Streets and even to the vicinity of Federal Hill on the other side of the basin. Potter noted in 1800 that the increment of cases could be calculated with tolerable accuracy by observing the variations of the winds. Reese, in his history of the epidemic of 1819 which began at Smith's Dock, Fell's Point, attributed the spread of the disease from its first circumscribed limits to the strong easterly wind which lasted for several days. Shortly after a day of fasting and prayer, instituted by the mayor on petition of the clergy, the wind veered suddenly from the southeast to the northwest, "and blew with such force from that quarter that the basin was thoroughly washed out, a general cleansing of the filthy situation of the docks was the result, and the evidences, which had been previously offered that the disease was progressing towards the healthier districts of the city, ceased to be exhibited." In this connection, it should be stated that Reese records that in this year, yellow fever appeared at the same date at both the lazaretto and at Fell's Point. The lazaretto was some 2 miles to the east and south of Smith's Dock at Fell's Point, and between them were the large filthy ponds previously alluded to. At or near the same time that the disease appeared at the lazaretto and at Fell's Point, it prevailed also at Fort McHenry, immediately opposite the lazaretto. In the light of our present knowledge, it is almost certain that the disease was commonly introduced by shipping either at the lazaretto, where ships first entered and were detained, or at Fell's Point, where they unloaded after passing the quarantine. A southeasterly wind tended to blow mosquitoes from the lazaretto and its neighborhood to Fell's Point and from the Fell's Point district to the lower portion of the city about the basin. A more easterly wind passed over the lazaretto to Fort McHenry at the end of Whetstone Point. A northwest wind would blow mosquitoes away from the city towards Fell's Point and from Fell's Point towards the lazaretto and over Whetstone Point to the Patapsco River.

It was recorded by a number of observers, but with particular emphasis by Potter and Reese, that the only individuals residing in the higher parts of the city who developed yellow fever in these various epidemics were those who visited infected districts, usually Fell's Point, at night. Davidge, however, records that a considerable number of persons from the higher parts of town who went to Fell's Point to witness the launching of a frigate contracted yellow fever during the epidemic of 1797. It was emphasized in all records that no one developed yellow fever after contact with cases outside of the yellow-fever afflicted districts of the city. Davidge distinctly stated that from none of those persons living up town who contracted the disease at the launching of the frigate did the disease spread. Potter stated that in not a single instance was the disease communicated to their associates by those persons who, living in the higher parts of the city, contracted the disease after visits to the lower portions of the city.

During these epidemics, but particularly in that of 1819, great numbers of people from the infected districts were removed to the higher portions of the city or to the surrounding country. Dr. Allender and Dr. Clendinen (36), are recorded as saying that " those who were seized with the disease and removed did not propagate it, nor was anyone infected from the atmosphere by those who imbibed the poison at its sourse." In 1819, great numbers of yellow-fever patients were removed from Fell's Point to the hospital situated in the high portion of the city on Broadway and Monument Street, and it was affirmed by Reese that not a single case of the disease occurred among physicians, nurses, or visitors to the hospital.

Reese was a strong adherent to the doctrine of the indigenous origin of yellow fever and was thoroughly convinced that the disease was not contagious. He was, therefore, an emphatic opponent of the usual quarantine system and condemned the British physicians who advised their Government that yellow fever was highly contagious, although a case of the disease had never occurred on the island. While recognizing that the local quarantine laws were so ameliorated that Baltimore did not suffer half the inconvenience and delays of other places, still he regarded the Baltimore practices as grossly absurd. He proposed the following principles of quarantine:

" If a vessel arrive from a foreign port, where it is known that at the time of her departure the disease raged with unimpeded violence, let this vessel be examined by the health officer; the sick, if any, removed; and if necessary the vessel be cleansed and then suffered to proceed to her destination. This could all be done in forty-eight hours. If, on the contrary, the vessel should be found to contain any vegetables in a state of putrefaction, or if persons had been diseased and died on the passage after the vessel was out at sea, then some detention should take place; but the healthy individuals on board ought to be permitted to proceed to their place of destination. This kind of quarantine would be consistent with the facts, and would prevent the importation of any contagious disease more effectually than the one at present in vogue."

For another reason he protested against quarantine regulations. He held that the practice of detaining vessels at a lazaretto 12 to 40 days, in the heat of summer, without any cleansing or ventilation, was calculated to effect what it was intended to prevent. If such vessels thus proscribed contained coffee and other substances liable to undergo putrefaction, they would at least be injured by the detention, and if they were damaged at all, the lack of ventilation would increase the damage.

"Such vessels are then permitted to proceed to the center of our cities, the hatches are removed, and the gas evolved from their holds is so fetid and poisonous that whole cities are infected by the noxious vapor generated during the detention of the vessel; and if she had been suffered to come up to unload at once upon her arrival, no mischief would have resulted, but much evil would have been avoided."

He deprecated copying European authorities either in politics or science.

In connection with the idea of the indigenous origin of yellow fever, Potter stated that when, in consequence of the embargo on foreign commerce in 1807, no foreign sail appeared in the Baltimore Harbor, yellow fever broke out at Fell's Point.

These ideas were supported by the opinion of the organized profession in a letter (36) signed by Dr. Ashton Alexander and Dr. John B. Caldwell, secretary of the District Medical Society, written in reply to a letter of David Burke, chairman of the committee of the city council in charge of the health ordinances, who had propounded seven questions concerning the causes of yellow fever and its relation to local conditions. In the letter referred to, Dr. Alexander and Dr. Caldwell, after describing the general sanitary conditions of Fell's Point, stated definitely that, in the opinion of the society, the yellow fever of 1819 was to be ascribed to the decomposition of vegetable matters about the wharves, in the streets, the ponds, and cellars. They explicitly stated that the society did not consider the putrefaction of animal matters competent to the production of yellow fever, and that "the doctrines of contagion and importation received no countenance from this society." They expressed belief that the cause of the disease may be imported, if by this is understood a cargo of vegetable substances in a putrescent state. They had observed no differences in the habits and modes of living of the people in the infected district from those of the people of the same rank living in parts of the city where the disease did not prevail. In regard to the organization of the board of health, they gave it as the opinion of the society that it should have at least one medical member with whom to hold counsel and to whom they might refer on points touching the health of the city. They recommended that the quarantine regulations should be strictly enforced in all cases where the cargoes were damaged or the vessel in a foul state, until a change of conditions would safely permit her entrance into the port, but this recommendation was not intended to deprive the passengers or crew of the privilege of free communication with the city.

These recommendations ended in a complete recasting of the health department, and the new health ordinance of February 29, 1820, framed after the last great yellow-fever epidemic, under the influence of the Medical Faculty and under the mayoralty of Dr. Edward Johnson, a leading physician, contained no quarantine provisions.

In the light of the foregoing, it is well rapidly to review the correlation between these ideas and the quarantine regulations and practices of Baltimore. From the above facts, quoted from contemporary literature, and from a consideration of the health ordinances, it is clear that the early quarantine regulations and practices were determined by the ideas held concerning the etiology and mode of transmission of yellow fever. The ordinances of 1797 provided a 10-day quarantine on ships and their personnel, arriving from beyond the seas and "all other suspected places," only during the months between April 1 and October 1 (the yellow-fever season), and gave the health authorities power to

interdict the landing of damaged coffee, hides, or other damaged material—substances from which it was believed the cause of yellow fever might arise.

Four years later, in 1801, the quarantine restrictions were limited to vessels from both the Indies, Africa, South America, the Mediterranean, and connected waters east of Gibraltar, and the ports of the western coast of Spain, as far as Cape St. Vincent, but only between May 1 and November 1. The primary quarantine period was 3 days, with extension by an additional 10 days, at the discretion of the quarantine officer. Vessels from such ports were, however, required to discharge cargoes and ballast at the quarantine station, and ventilation of the ship and wearing apparel of persons on board was enforced. Vessels loaded with coffee (from West Indian or other ports), arriving between June 1 and October 1, could discharge cargoes into lighters instead of at the quarantine station. Under both ordinances, the sick on vessels were sent to the hospital at Hawkins' Point. The restriction of the quarantine season to the four or five hot months, the short duration of detention, and the mildness of the regulations in regard to ships, goods, clothing, and persons, and the total abandonment of all quarantine regulations between 1808 and 1821 prove that the quarantine system was directed against yellow fever especially, rather than against plague, small-pox, typhus fever, or other diseases. It is to be noted that when the health ordinances were entirely recast in 1820, when by common consent yellow fever was regarded as of local origin and not contagious, all provisions for quarantine of the port were omitted. The very liberal quarantine laws revived in 1821 and expanded in 1823, while still stressing the importance of materials, provided for the examination of persons and prepared the way for the more stringent investigation of persons, both crew and passengers, made mandatory in the revised health ordinance of 1826. The latter and various successive ordinances left general details of the quarantine system to the quarantine officer and the board of health. By 1826, the tide of immigration to Baltimore from Europe, which had set in after the close of the Napoleonic wars, had reached a high point, and it was to protect the city against small-pox and typhus fever likely to be brought in by these immigrants that the quarantine system was revived in its new form. So far as yellow fever is concerned, the Baltimore authorities prided themselves that they never instituted quarantine against any port on account of that disease, and they sharply criticized Alexandria, Virginia, for imposing quarantine restrictions upon Baltimore for that reason. During the severe epidemics of this disease at Norfolk, Portsmouth, and Gosport, Virginia, in 1855, Baltimore kept up active trade with her stricken sisters, and welcomed their refugees in large numbers. So convinced were the Baltimore authorities of the unwisdom of a stringent quarantine system that, in 1830, Dr. Horatio G. Jameson, the consulting physician of the health department, went to an international meeting of hygienists in Hamburg with the purpose of inducing continental authorities to modify their quarantine regulations to conform with those of Baltimore. In 1832, when an invasion of cholera was imminent, Dr. Jameson held that this disease is not contagious and that restrictive measures should not be attempted. Though the mayor agreed with him, on account of opposition on the part of the council and the public, they were unable to act consistently with this doctrine.

On account of the lack of the reports of the health officer or quarantine physician before 1827, it is not possible to review with any accuracy administrative practices of this official under the quarantine laws before this date. It is probably correct to assume that he carried out the spirit, if not the letter of the ordinances which obtained. It will be recalled that by the ordinances of 1823 and of 1826, the quarantine was reestablished with the retention of the better features of the old laws, and that by the late ordinances the health officer, under the commission of health, was to determine whether and to what degree quarantine should be imposed on coastwise and foreign vessels.

All vessels were required to anchor at the quarantine-ground for examination of the passengers, crew, and cargo. The health officer passed them at his discretion. Vessels that he held for quarantine were sent to the lazaretto for cleaning and for the discharge of cargoes and passengers. Private vessels and vessels with more than 15 passengers, arriving from sea were required to land their ballast and empty and cleanse their water casks at the lazaretto wharf. Their timbers were inspected by the health officer before the vessels were permitted to come to any wharf within the limits of the city.

As a matter of practice, as shown by the annual reports of the quarantine officer since 1827, it had been the custom to retain at quarantine cases of yellow fever, cholera, small-pox, typhus fever, and occasionally scarlet fever, measles, and malarial fever from incoming ships, and in case of small-pox on board to vaccinate everyone, both crew and passengers, and to pass the ship after disinfection. The methods of disinfection included removal of the whole cargo and airing it at the Lazaretto, cleaning and washing the ship, and the use of various disinfectants.

As an indication of the amount of work entailed during the quarantine period of 1827, there were 546 ships, of which 177 were from foreign ports and carried 1,429, out of a total of 1,688 passengers. In 1829, 4,600 passengers were inspected by the health officer. From 1827 to 1834 it was recorded that the health officer examined 44,821 passengers, of whom 40,973 were foreigners.

The clothing of those sick with small-pox, or typhus or yellow fever, was usually sunk or burned, but, for a while at least, it was passed after being well aired.

The health officer made frequent comments upon the condition of immigrant passengers. In 1829, he states that the passage money of many of the immigrants was provided by the parish from which they came. He often remarked upon the destitute and filthy condition of the immigrants and upon their corporeal and mental disabilities, which caused the assignment of many of them to the Baltimore almshouse. In 1837 he estimated "that 75 per cent of the immigrants included the halt, lame, blind, mendicants, and persons unacquainted with any kind of business except laboring." Many of the immigrants at this time were Irish and German.

Ships from infected ports were passed if the personnel was healthy, the ships clean, and the cargoes without damaged goods. "Damaged goods" were those that showed evidences of spoiling and putrefaction, chiefly coffee and hides, and they were aired at the lazaretto before being brought to the city. Until the goods were submitted to this process for an uncertain period they were not allowed to be brought to the city. The health officers were greatly

exercised over the foul condition of the holds of vessels and apparently had more trouble with coastwise than with foreign vessels on this account. In 1829, Dr. Samuel B. Martin, the health officer, reported much benefit in cleaning the holds of vessels from the use of "chlorine in combination with lime." This is the only mention made of the use of a particular disinfectant, but it is probable that lime was most commonly used for this purpose.

These practices were enforced with little modification until 1847. The reports of the health officers during this period indicate that careful examinations of crew and passengers were carried out routinely, particularly for small-pox, typhus fever, and yellow fever, as well as for cholera during epidemics of that disease. One of the practices early established was that of vaccinating both passengers and crew when a ship was held for either small-pox or typhus fever. No indication is given as to how long ships with infected passengers were held or for how long a period well persons on infected ships were quarantined. The sick were removed at once to whatever hospital accommodations were available.

It does not appear from the records when removal and airing of cargoes and the cleansing of vessels were stopped. The abandonment of these practices apparently coincided with the adoption of uniform quarantine plans for all ports, under the general direction and with the co-operation of the United States Marine Hospital Service and its successor, the United States Health Service after 1880.

Throughout the history of the quarantine service, both before and after its modifications to conform in a general way with the restrictions and methods advocated by the Federal Government through the Marine Hospital and Public Health Services, it has been the practice of the health department to hold at the quarantine station discovered cases of small-pox, typhus fever, yellow fever, cholera, and severe cases of malaria.

THE LAZARETTO AND HOSPITAL FACILITIES IN CONNECTION WITH THE QUARANTINE PORT.

Baltimore City inherited from Baltimore Town a small quarantine hospital, the construction of which had been authorized by the legislature at the time of the yellow-fever epidemic in 1794. It was situated at Hawkins' Point, on the southern shore of the Patapsco, due west across the river from Sparrow's Point and Fort Carroll, about 4.5 miles due south from Fort McHenry, and about 3.5 miles southwest from the Lazaretto Light. It was probably reached only by boat. There is no record of the number of patients with yellow fever or other diseases that were accommodated there. It was completely under the jurisdiction of the Baltimore Health Department and was probably in use until 1830. In that year arrangements were made with the Director of the United States Marine Hospital Service in Baltimore to have the most comfortable part of the lazaretto fitted up with plain accommodations for the reception of cases of contagious diseases arriving on ships. The lazaretto for the reception, airing, and cleansing of goods taken from ships was owned by the United States Government and was established shortly after 1801 at Lazaretto Point, about 2 miles southeast of Fell's Point, just across the river from Fort McHenry, and at the junction of the southern and eastern boundary lines

of the city as they existed from 1816 to 1919. It is probable that the health officer boarded ships from the lazaretto until 1807, when his office was established at Fort McHenry. The lazaretto was a large quadrangular building, but there are no plans extant, giving the size and plan of the lazaretto buildings and wharves.

The first lazaretto was destroyed by fire in 1836. The Marine Hospital Service apparently had no hospital for sailors sick with ordinary diseases until recent years. For many years, at least, they were evidently sent to different hospitals in the city.

About 1845 there was constructed by the city a new quarantine station of considerable size, called the Marine Hospital. It was situated at what is now known as Fairfield, on the southern shore of the Patapsco River, about 1.25 miles directly south of Fort McHenry. This hospital, while designed primarily to accommodate sick immigrants, was provided with additional accommodations to be used as a pest-house chiefly for cases of small-pox and typhus fever from the city. It is evident that the accommodations at the pest-house were at times insufficient to accommodate all the cases of typhus fever taken from vessels at quarantine, for Thomas H. Buckler records that in 1847 some of the first cases of typhus fever brought by the ship *Rio Grande* were sent to the medical wards of the Baltimore City and County almshouse and that with the repeated arrival of immigrant ships with cases of the disease, these wards were filled with typhus cases in the course of a few weeks. The name, Marine Hospital, was a misnomer, for it was not a hospital for mariners, but for immigrants, as well as a pest hospital for the city. It is probable that, at times at least, sailors with communicable diseases were received there. For some years this hospital was under the charge of a resident physician, but later the health officer or quarantine officer was given charge of it.

It appears that during the Civil War the United States Government erected a flimsy barrack hospital on these grounds, and after the war this structure was taken over by the city as a pest hospital.

In 1881, the quarantine station was moved to Leading Point, about 8 miles below Fort McHenry. Here two wooden structures were erected, one for sailors and passengers with contagious diseases and the other, a large, barrack-like structure, as a pest-house for the city. In connection with the hospital there is a large steam disinfecting plant.

Both the old Marine Hospital and the quarantine station at Leading Point were best reached from the city by water. The road to the former was always excreable and that to the latter, until recently, was rough.

THE EFFECTIVENESS OF MARITIME QUARANTINE.

As will appear very clearly in the separate studies of the course of various epidemic diseases, the quarantine station of the Port of Baltimore did not, until very recent years, at least, offer a very efficient barrier to the ingress of certain diseases, epidemic waves of which have repeatedly broken over the city.

In nearly every year between 1794 and 1807, the period of most stringent quarantine laws, there were larger or smaller epidemics of yellow fever. In the latter year, owing to an embargo on shipping, no foreign vessels entered the port. In 1793 there was a large immigration from San Domingo, but no

cases of yellow fever were recognized in the city. These immigrants arrived at the time when the local quarantine was under the State officials. Within the next 20 years, partly on account of this immigration, there was a great increase in trade with the West Indies, and particularly with San Domingo. Although between 1807 and 1821 there were no quarantine laws in force, yellow fever was recorded in Baltimore only in 1819 and 1821. From 1812 to the spring of 1815, shipping was to some degree interferred with on account of the war.

The reports of the quarantine officer are available from 1827. These contain no records of the detention of cases of yellow fever until 1848, when there was 1 case. Between 1848 and 1900, a period of 52 years, there were removed from vessels a total of 83 cases of yellow fever, 28 of which were detained in the 5-year period 1855–1859. The largest number of cases detained in a single year was 12, in 1855; 10 cases were detained in 1870; 6 cases in 1857 and 1884; 5 cases in 1859, 1873, and 1877; 4 cases in 1856, 1874, and 1894; 3 cases in 1891; and 2 cases in 1849, 1853, 1872, 1875, 1879, and 1897. In nine other years there were single cases. In 1853, when 2 cases were detained at quarantine, there were 18 fatal cases in the city, and in 1859, when 5 cases were taken from vessels, 5 cases occurred within the city. It is of special interest that in 1855, with 12 cases at quarantine, there were 13 deaths from the disease in the city, occurring among refugees from the cities at the mouth of the Chesapeake Bay, but from none of these cases did secondary cases arise. Cases of the disease were detained each year at quarantine from 1872 to 1881, inclusive. It is not known, of course, how many cases occurred within the city among individuals passed at quarantine.

After 1831 there was a drop in the West Indian trade, but a gradual increase in shipping from South American ports.

Though it is certain that typhus, jail, or ship fever was early included among the "pestilential diseases" by the local health department, the records of the quarantine officer made no mention of detained cases of this disease before 1845. The tables of interments, however, show that deaths from typhus fever occurred in the city every year from as early as 1813 at least until 1861, and that this disease was the cause of a considerable number of deaths in 1814-1815, 1818-1820, 1823-1824, and 1847-1850. (See Table 17.) Since cases of typhus fever and small-pox, originating within the city, had been sent to the marine or quarantine hospital by 1845, it is impossible to determine what proportion of the cases recorded at the station were taken from ships. However, during the time of the great Irish immigration beginning in 1847, a considerable number of cases were recorded at the quarantine hospital: 101 in 1847, 14 in 1848, 140 in 1849, 6 (all said to have come from the city) in 1850, 10 in 1851, 54 in 1852, 30 in 1853, 23 in 1854, and 6 in 1855. Only 3 cases of typhus fever were recorded between 1857 and 1869: 2 in 1857 and 1 in 1866. In 1870 there were 282 cases, and in 1871, 17, probably most of them from the city. Since this date there have been a few cases recorded in occasional years.

In only a few years between 1850 and 1919 were there no cases of small-pox recorded at the quarantine station or its hospital. However, as from the earliest times cases of this disease were sent from the city to whatever hospital existed in connection with the station, it is not possible to estimate what proportion of the recorded cases represent cases removed from vessels. In the older reports,

from 1827 to 1847, specific mention is made of removal of cases from vessels, as, for instance, 2 cases in 1827, 1828, and 1831, respectively, "several cases" in other years, 16 cases in 1836, and 30 cases in 1837. Often the name and nationality of the vessel, usually German from Bremen, is given. After 1845, when a ward of 20 beds was provided for small-pox patients at the Marine Hospital, considerable numbers of cases are known to have been sent from the city, and in some years the number of such cases is given. These years mark the known epidemic years of small-pox in the city. In some of these years the cases numbered hundreds.

Cases of cholera are recorded as having been removed from vessels only twice, once each in 1850 and 1866. Cases of cholera were looked for by the quarantine officer in 1832, the great cholera year, but none were discovered on ships entering the port.

After 1847, malaria, typhoid fever, and occasionally scarlet fever and measles are mentioned. Though not stated in the reports, it is a well-attested fact that the authorities permitted large steamship companies to enter into contracts with general hospitals in the city to receive cases of scarlet fever, measles, and diphtheria from their vessels, and that there was a competition between at least three such hospitals for these contracts. The city's hospital facilities at quarantine were, and are yet, hopelessly inadequate to accommodate more than a few such cases. Indeed, until very recently, no attempt was ever made to prevent the importation of cases of these diseases directly into the city. Before 1850 they were not regarded as "pestilential diseases." As late as 1893 it was not unusual for one of these general hospitals to receive as many as a hundred cases of measles from a single North German Lloyd immigrant steamer.

In regard to typhus and typhoid fevers, small-pox, measles, scarlatina, diphtheria, influenza, and probably cholera, the dispassionate student is forced to the conclusion that the quarantine system, as applied at the port of Baltimore and at other Atlantic seaports, until recently was futile. In 1851, Thomas H. Buckler (11) pointed out that in 1847 typhus fever was diffused throughout the city by Irish immigrants who were passed by the quarantine authorities, and he severely criticized the quarantine facilities and methods of the port as inadequate. Many, if not most, of the severe European epidemics of these diseases have been reflected in Baltimore. No quarantine system has kept them out of some port, and, having visited the country, they have spread to Baltimore through her otherwise open portals if not through the only partly closed door of the quarantine station. That at times a few cases of one or another of these diseases have been kept from entering by this portal may be assumed.

It is very probable that since 1845 the maritime quarantine has served a good purpose in preventing the ingress of cases of the severer types of malarial fever from Central and South America. This is counterbalanced, however, by the fact, attested by the quarantine physicians, that many patients with small-pox and typhus fever sent from the city to the old Marine Hospital died of malarial fevers contracted there.

A fair evaluation, at this late date, of the efficacy of the quarantine in preventing epidemics of yellow fever in Baltimore is almost impossible. The facts must be faced that during the early years of most active quarantine the disease was prevalent in epidemic form nearly every year; that when the quarantine

was done away with, it occurred but twice in 16 years; that after the quarantine was reestablished in 1821, though cases of the disease are known to have existed in the city on several occasions, it has never spread generally; and that moreover, in some years when no cases were detained at quarantine, the disease broke out in the city, as, for instance, in 1854, when over 40 cases occurred at Fell's Point. *Stegomyia* mosquitoes, which must have been present in the lower parts of the city as late as 1821, could hardly have been done away with by the unconscious and incomplete anti-mosquito work of that date. The most reasonable explanation is that quite fortuitously those yellow-fever patients who did get into the city, in 1855 for instance, did not go to the lower portions of the city at Fell's Point and the basin near Jones Falls. It is more than likely that, until late years, chance, rather than art, has controlled this situation.

In regard to bubonic plague, little need be said, for history shows that this disease has never been, at least not until recently, a menace at Atlantic ports, any more than at British ports during the same period. Until the last part of the nineteenth century the disease had not migrated to Europe or to America for centuries, and since that time it would appear that when it approached a port it has often entered despite quarantine. Even when it has gained admission and has spread widely among rodents, as in San Francisco and New Orleans, the disease has never attacked man in grave epidemic form. It seems that the immunity of western Europe and of America to deadly epidemic plague since the seventeenth century is to be explained by the natural history of the disease rather than by man's precautionary efforts. No one who is familiar with what is known of the natural history of this disease can entertain the idea that the quarantine system of Baltimore, at least before 1900, could have possibly afforded any protection against its invasion.

Chapter VI.—Public Health Administration within the City.

I. Introduction: Developments and accomplishments of public health practice in the nineteenth century, based upon ideas and methods long existent and determined very largely by the more general diffusion of knowledge and wealth among peoples of intellectual and personal freedom; Influence of modern micro-parasitology; Reasons for vigorous attacks on nuisances rather than on contactive diseases.

II. Measures of nuisance prevention and abatement directed against nuisance-borne diseases: Definition of nuisance; Prevention and abatement of nuisances on public property—Dredging and filling; Grading and paving; Street cleaning and garbage removal; Sewerage; Water; Food; Prevention and abatement of nuisances on private property—Standing water; Organic matter; Manufactories; Habitations.

III. Measures of restriction directed against contagious diseases: Isolation, inoculation and disinfection. (Tables 4 to 6.)

INTRODUCTION.

It is customary to date the beginning of modern public-health administration and practice in municipalities from about the middle of the nineteenth century and to attribute the general sanitary reforms which were actively undertaken at this time in certain European and American cities to newly acquired knowledge. And especially is it the habit to ascribe to advancing knowledge in micro-parasitology the more vigorous efforts to control disease by measures of general sanitation and of personal control which have been made during the past 40 or 50 years. It is, however, a great mistake to suppose that these activities had their origin directly in any very essentially new knowledge discovered by the generation by which they were undertaken. The final establishment upon a firm basis of the ancient germ theory of the causation of the febrile diseases did not in principle add nearly so much to the methods available for preventing the spread of these diseases through communities or from place to place as those ignorant of history have assumed to be the case. While the newly acquired knowledge changed reasons assigned for the employment of certain measures, it did not modify methods of practice in any very fundamental manner. Tactics rather than strategy were modified, but neither was greatly enriched, so far as the typically contactive diseases are concerned, to a degree that can be called revolutionary. It is so widely believed and taught that the decrease in incidence and in mortality of so many of the acute and chronic febrile diseases in western civilization has been due solely to the application of new methods of sanitation and of personal control based upon the wonderful advances in our knowledge of micro-parasitology within the past 50 years, that it is well at this point to submit this claim to critical analysis.

In the first place, the beneficial influence of an abundance of pure water for drinking and bathing, of surface and sanitary sewerage, of sanitary latrines for the disposal of human dejecta, and of well-paved and well-cleaned streets upon the public health and comfort was well-known to the ancients. The

Romans, especially, brought these measures to a high degree of perfection, and their practices in these respects became well known to students, at least, with the revival of the study of classical literature during and after the Renaissance. The Romans set up a health department, effectual so far as matters of general sanitation are concerned, under the administrative charge of the ædiles, with district physicians who attended the poor and were on the outlook for epidemic diseases. A similar system was revived in certain Italian cities, notably Venice, in the fifteenth century. According to Manzoni (37), before the plague epidemic of 1630 Milan had a permanently organized board of health, with physicians among its members and with lazarettos for the isolation of the sick. It will be recalled that the quarantine system of the Mediterranean ports was elaborately organized in the seventeenth and eighteenth centuries. On Mead's advice this system was copied in England for emergencies in 1720. Mead's (14) "recommendations" for the control of the spread of the plague in England embodied all the essential principles of restriction of contactive diseases by measures directed to the control of persons and their immediate contactive environments in use at the present day. The fundamental importance of Mead's recommendations is evident from the following synopsis:

1. Local health councils with physicians and magistrates among the members should be established and exercise full authority.
2. Physicians should be employed to search out cases and a reward offered to the person reporting the first case in a community.
3. When cases of the disease are found in households or elsewhere, the sick should be separated from the sound, by removing the former, preferably at night, to clean and airy habitations 3 or 4 miles out of town (hospitalization), and given every care and attention.
4. The sound in such households should be well washed and shaved and given fresh clothes before removal to lazarettos for observation. The clothes previously worn should be burned or buried.
5. All the goods within houses from which the sick are taken should be buried. The houses should be either demolished, or else thoroughly cleaned and replastered, and fumigated with vinegar or sulphur.
6. The bodies of the dead should be buried deeply.
7. Those attendant upon the sick, while near the latter, should not draw in their breath nor swallow their saliva, but should frequently wash the mouth and nose with a solution of vinegar.
8. Healthy inhabitants who could afford it should be allowed to leave the town, after undergoing a period of detention in isolated detention camps for 20 days.
9. Assemblages of people should not be allowed, and beggars and idlers should be confined.
10. Proper authorities should see that the houses of the poor are kept clean and sweet. Whenever an overcrowded condition is discovered, some of the dwellers should be removed to other quarters.
11. Streets should be washed clean and kept free of carrion and other nuisances. Laystalls should not be too near the city.
12. Lines should be cast about infected towns, and guards should prevent persons from passing to other places until they have performed a quarantine of 20 days under suitable precautions. All travelers should have certificates. No material considered retentive of infection should be passed through the lines.
13. All the expenses incurred should be borne by the public.

These measures against plague, advised by Mead, and evidently largely borrowed from Italy, have been given the credit of checking the spread of the disease. They were applicable, and doubtless were applied, to other epidmic diseases, and provision for such application, in part at least, to Baltimore was made in the earliest health ordinances. In regard to the typically contagious diseases, these regulations were equally applicable, whether it be held that these affections are caused by emanations of unorganized form from the bodies of the sick, or by contagia viva, or micro-parasites. Whichever the true explanation of their causation, separation of the sick from the well, avoidance of contact with the sick and the articles of their contactive environment, the destruction of these articles by fire or their purification by chemicals, ventilation, and sunlight, have been and yet remain standard procedures. The necessity of early notification of the occurrence of cases of disease in order that standard precautionary measures could be taken and of holding suspects during the period of incubation was as evident in Mead's day as in this.

Vaccination against small-pox has been available as a public-health measure since 1798 and has been practiced in Baltimore since 1800, but, as elsewhere, in a fashion quite inadequate. But the value of variola inoculata as a preventive measure against variola vera or small-pox was announced in England by Lady Mary Wortley Montagu in 1716, and in 1744 the western world was informed through Mead's publication of an English translation of Rhazes's classical work on small-pox that the Chinese and other eastern peoples had for centuries employed successfully variola inoculata as a substitution disease against small-pox. Indeed, the great virtue of Jenner's discovery lay in the fact that vaccinia is a milder affection than variola inoculata and that its use avoids keeping the small-pox virus alive in a community.

Almost from time immemorial, pulmonary tuberculosis, like leprosy, has been held to be spread by intimate personal contact; yet the latter, during many centuries, has been combated by segregation (and apparently with great success in Europe), while restrictive measures against the former have come into vogue only in recent years, and then on a very restricted scale. When the difference in man's conduct toward these two affections is considered, it seems likely that his actions must have been governed more by vanity and horror than by reason. It is doubtful if leprosy was ever, within historic times, endowed with a force of morbidity and mortality of the same high degree as was pulmonary tuberculosis. The disease of lesser frequency is characterized, however, by visible lesions leading to hideous deformities and superficial decay and attended by feelings of despair, while with its more common and usually more rapidly fatal sister the lesions are hidden, hope commonly persists to the end, and the victim inspires sympathy rather than disgust. It is interesting to speculate on what would have happened had the ancients applied segregation to the pulmonary tuberculous with the same determination with which they exercised it on the leprous.

It would appear that until the middle of the nineteenth century western Europe and North America were stirred to activities of disease control only by deadly epidemics, mainly those of diseases marked by horrible external characters. Small-pox, disgusting to sight and smell and marked by facial deformities and blemishes in the recovered, plague with its discoloration of the skin

and its suppurating buboes, and the contagious ophthalmia of the East, disfiguring man's best feature and commonly leaving a legacy of blindness, all illustrate this point. Typhus fever, influenza, scarlet fever, measles, diphtheria, whooping-cough, syphilis and gonorrhœa, and the less dangerous mumps and varicella—diseases then and now commonly reckoned as contactively spread—excited only occasionally administrative reactions of a protective nature. Syphilis has excited popular dread only when its victims showed superficial lesions with destruction of tissue and disgusting appearances and odors. The same may be said of superficial tuberculosis or scrofula. Gonorrhœa is yet regarded popularly as too mild a disease to call for the use of the obvious measures to avoid it.

In Baltimore the early sanitary measures undertaken against diseases supposedly caused by effluvia from the decaying of dead organic matter were inspired as much by the fear of the dreaded yellow fever as by fear of the customary, annual visitation of malarial diseases, to which a great proportion of the deaths were attributed every year.

Against endemic affections of steady march and less spectacular lethal capacities, man commonly exhibited stolid indifference, fostered by familiarity, superstition, and a feeling of helplessness.

The discovery since 1898 that malaria and yellow fever are carried by mosquitoes acting as intermediary hosts, and that typhus fever is spread from sick to well by body-lice, was not essential for a considerable control over, if not for the eradication of, these diseases, and, indeed, they all had shown marked regression and had practically disappeared in many countries before this time. In fact, it is not going to far to state that malaria and yellow fever had been eliminated or in great degree curbed in many places, including Baltimore, long before it was demonstrated that they are caused by micro-parasites and under natural conditions, at least, transmitted only through the mediation of certain species of mosquitoes. Measures directed against standing water, such as draining and filling low grounds, making cellars dry, sealing cesspools, planting trees, and the like, are, of course, of equal value in preventing mosquito breeding and the formation or the escape into the air of effluvia from decaying organic matter. The avoidance of low grounds and of exposure to the open air at night, precautions taken for empirical reasons, are efficacious for escaping malaria and yellow fever, when prevalent, whether adopted under the influence of the marsh miasma or the mosquito theory. The mosquito net and the window screen were in general use long before the relation of these insects to the spread of these fevers was discovered. Finally, the value of routine doses of cinchona bark, or of its active principle, quinine, in warding off malarial infection in malarious districts has long been recognized. This practice was successfully employed in the eighteenth century in armies, in the British navy, in the British settlements on the Guinea coast, and elsewhere. During the nineteenth century, preventive doses of cinchona bark or of quinine in whisky or brandy (as first used in the Imperial army on the Danube in 1717–1718) became a commonly practiced measure of personal hygiene in Baltimore. According to Dr. W. T. Councilman, this prophylactic remedy was furnished by the Baltimore health department as late as 1880 to the officials and help at the quarantine station, which was situated in a severely malarious

district. It was taken twice daily by the whole force, and by one employee in amounts sufficient to cause permanent deafness. Until very recent years it was the fixed habit of physicians in Baltimore to pour quinine into patients suffering with various diseases whenever a "malarial complication" was suspected. As dysentery was believed to be an "expression of malarial intoxication" (and doubtless the two diseases often coexisted in the same individual), quinine, or "the bark," was commonly administered for this disease as a matter of routine. It is a curious fact that until very recently health departments failed to advocate the use of prophylactic doses of quinine for the control of malaria, and not until much later did they distribute quinine free of cost. The latter measure of health protection was not adopted until long after the free distribution of diphtheria and tetanus antitoxins and other curative and prophylactic sera and of vaccine and various bacterial vaccines. In Baltimore the records show that far more deaths were credited to malaria than to small-pox, and for many years malaria certainly killed more than did diphtheria.

For illustrations of the effectiveness of sanitary measures and cinchonization of populations upon the course of malaria, long before the discovery of the malarial parasites and the influence of the mosquito in their spread from man to man, it is only necessary to follow the epidemiology of this disease in England, in western Europe, and in the northern States of America.

Malarial fevers, in severe and fatal form at least, had disappeared from large sections of England, France, and Italy, and even the Low Countries, long before the discovery of the causal agents and their spread by intermediate hosts, under treatment, both curative and preventive, by "the bark" and through measures directed against standing water and putrefaction of vegetable material on the marsh-effluvia theory. The non-contagious character of malaria was well established centuries ago and of yellow fever early in the nineteenth century. The experiments of Ffirth and of Potter showed as conclusively as did those of the Reed Commission nearly 100 years later that yellow fever can not be spread by fomites, and furthermore proved that in the height of the disease successful transmission from one human being to another by direct inoculation of the black vomit and of whole blood into the stomach is not practicable.

Typhus or goal fever was shown in Mead's time to be successfully combated by measures directed toward personal cleanliness, such as shaving, hair-cutting, bathing the body, and the destroying or disinfecting by heat or chemicals of clothing, bedding, and the like. This fact was amply verified later by Pringle, Monro, Lind, John Howard, and others. The relation of overcrowding, famine, and wars to the spread of typhus fever was as well or even better appreciated then than at present. Indeed, typhus fever in epidemic form had died out in western civilization long years before the relation of the body-louse to the transmission of the disease was discovered. Thus, by the middle of the nineteenth century, typhus had, without any special sanitary measures directed against it by public-health authorities, become a disease of comparative rarity except in Ireland, Poland, Russia, and the poorer parts of Germany, Italy, and southeastern Europe, in which localities the mass of the people was poverty-stricken and lived continuously in those conditions of filth that favor verminous infestation.

In English, and even in Scotch cities, without organized health departments, typhus fever became relatively uncommon and was confined to the very poor and to Irish immigrants, by whom it was being constantly imported. After 1840, the epidemics of this disease in Baltimore, as will be shown later, were imported from one or the other of its homes in Europe and spread only among those uncleanly through poverty and ignorance.

It will be recalled that long before the modern revival in sanitation, the great advances in knowledge of micro-parasitology, and the general acceptance of the germ theory of the causation of the communicable diseases, the idea (with which from their practices it is legitimate to infer that the ancients were familiar) that causation of the acute intestinal diseases is intimately associated with pollution of drinking water with human excreta had been revived or rediscovered. It has been shown in a previous chapter that David Monro recognized this association in 1763. Parkes (38) has pointed out that diarrhœal diseases were attributed to impure drinking-water at Göttingen in 1760, at Saarlouis by Walz in 1822, at Mayence by Müller in 1843, and at Vienna by Richter in 1848. By Austin Flint (39) at North Boston, N. Y., in 1843, and in England by Carpenter (38) in 1852, Rauth (38) in 1856, and very conclusively by Budd in 1859, the important relation between the spread of typhoid fever and polluted drinking-water was shown. The possibility of the transmission of cholera by drinking-water was pointed out by Jameson (38) in India in 1820, and by Müller (38) in Hanover in 1848. This means of transmission of cholera was clearly established by the work of Snow (40) in 1849, and especially by the experiences in connection with the celebrated Broad Street pump in London in 1854. The masterly paper of Snow in 1849 on the pathology and mode of spread of cholera appeared some years after the great sanitary reforms in London and certain other British cities in regard to purer water-supplies and more effective methods of sewage disposal had been undertaken on the old miasma theory. Snow argued that, since the primary and essential lesions of cholera are in the intestines and the *materies morbi* must be present and capable of multiplying in the exudation from the mucous membrane of these organs, the disease must be disseminated from sick to well through the intestinal discharges. From a large number of experiences drawn from London and elsewhere he arrived at two important generalizations; first, that numerous opportunities existed for the spread of cholera in households by transferring cholera dejecta to the mouths of attendants and others from stools and soiled bedding directly by the hands or indirectly through foods; and, second, that drinking-waters were impregnated with the unknown causal agent of cholera by contamination from drains, cesspools, and streams polluted with the intestinal discharges of cholera patients. He, therefore, advised that attendants upon cholera patients should wash their hands before eating, that soiled bed-linen should be boiled, and that fruit hawked about the streets (for the contamination of which there were many opportunities) should be avoided. Against infection by drinking-water Snow was no less definite:

"And, lastly, whilst cholera remains in the country, people should avoid using water which receives the contents of drains or sewers, or the refuse of persons navigating the water. Since anything touched by the hands may enter the mouth, it would be desirable to avoid even washing with such water; and, at all events, when no other water can be obtained, so much of it as is used for drinking and culinary purposes should be filtered and well boiled."

As late as 1873 Budd (41) felt it necessary to submit data to prove that "typhoid fever is a contagious fever propagated by a specific poison," that the intestinal lesions are the characteristic feature of the disease, and that "what is cast off from the intestine is incomparably more virulent than anything else." While strongly imbued with the idea that the disease could be spread through the air, he held the same views regarding the importance of the stools, bedding, and polluted water in the spread of typhoid that Snow had enunciated in regard to cholera. Budd laid great stress upon the importance of the disinfection of stools of typhoid patients, and he even considered it highly probable that the disease is spread by means of milk and butter. The demonstrations of Snow and Budd of the important relation between polluted water and the spread of cholera and typhoid exercised without doubt a considerable influence in accelerating the movements already on foot to secure purer drinking-water and safely to dispose of human dejecta, but their discovery of the rôle played by direct infection by the hands and of indirect infection through foods contaminated with the stools of those ill with these diseases did not bear fruit for many years. It must be recalled that the importance of infected milk in the transmission of typhoid, scarlet fever, and diphtheria was proven in the ninth decade of the last century as the result of epidemiological studies made without the assistance of the methods of micro-parasitology. Snow and Budd made the additional very important discovery, namely, that unsanitary conditions, such as overflowing and unprotected privies and cesspools and water polluted with night-soil and other putrescible matters, do not of themselves give rise to cholera and typhoid fever, but act as vehicles of transmission of their causal agents *after* these diseases have been introduced into communities. So deeply rooted in men's minds was the miasma theory in relation to the causation of the acute intestinal disease that it continued to flourish under the guise of the sewer-gas theory, overthrown in the later years of the nineteenth century by exact studies in micro-biology.

At the beginning of the nineteenth century some cities in Europe and in America returned to the ancient practices of obtaining general water-supplies from a distance, often from unpolluted water-sheds, and of constructing better and more adequate sewers. In these undertakings the inhabitants were influenced in part by the wisdom of the ancients and in part by the miasma theory of the origin of certain diseases. London and certain German cities which were not convenient to unpolluted lakes and streams had adopted by 1850 filtration systems of one kind or another. In many cases filtration resulted in clarification without purification. From this time on and until the development of water bacteriology, a reasonable degree of control of purification was maintained at some places by the use of the methods of chemical analysis.

The establishment of thoroughly efficient systems of water and sewage purification by the filtration method would be difficult, though not impossible without the discoveries of micro-parasitology. This does not, however, vitiate the argument, for in the case of both water and sewage this method is only one of several. Many cities, especially those situated on or near sea-coasts or on large rivers, obtain pure water and dispose of sewage satisfactorily without employing the filtration method for either. A knowledge of micro-parasitology

was certainly not necessary to guide Liverpool, Glasgow, and other cities to obtain pure water from distant lakes, Munich from nearby mountains, New York and Boston and great numbers of other cities from protected water-sheds, Chicago to divert sewage outfalls from water intakes, and to disclose the influence of large storage reservoirs upon water purification. The same may be said of water purification by chlorine and other chemicals. Sewage purification by filtration is and probably will continue to be the exception and not the rule. After all, it is by the incidence and mortality of the intestinal diseases, rather than by the tests and standards of micro-parasitology, that these questions are judged. It is not sought here to disparage these methods, the great importance of which will receive proper consideration in future chapters, but to point out that without them man possessed methods to obtain pure water-supplies and to construct safe methods of sewage disposal. Much more important agents to these ends than micro-parasitology were the invention and perfection of the steam-engine and the electric dynamo, without which many modern cities could hardly have been developed in their present form.

That the dangers of polluted water were realized in early Baltimore is attested by the facts that the commissioners appointed in 1803 to report on a general water supply were instructed to select a stream "for a copious and permanent supply of *wholesome* water," and as early as 1817 ordinances were passed designed to protect springs and wells from nearby privies and cesspools. Except where religious doctrines and racial prejudices have acted as controlling factors, as among the Jews, peoples of western civilization did not, until recent years, beyond avoiding food evidently tainted by putrefaction, concern themselves with the relation of foods to the spread of diseases. It is probable that the revival of the old germ theory of disease, or rather the demonstration that certain dangerous affections transmissible from food animals to man are caused by living parasites, is to a considerable degree responsible for the inauguration of the modern system of food inspection designed to protect man against anthrax, glanders, tuberculosis, actinomycosis, and trichinosis. As a matter of fact, however, the identity of most of these diseases in man and in the food animals was established at least as much by pathological anatomy as by micro-parasitology, and the relation of milk to the spread of such diseases as typhoid fever, scarlet fever, and diphtheria was established before the influence of micro-parasitology was brought to bear upon public-health administration.

It is clear, then, that, long before the days of modern micro-parasitology, there existed abundant knowledge and experience upon which to base large schemes of sanitation and of personal restriction for the control of morbidity and mortality of certain diseases. Some other reasons than ignorance and lack of ideas and methods must be found to explain dilatoriness of action. Some of these reasons are not difficult to find.

Europe, after the fall of Rome, through the Dark Ages, the Middle Ages, and well into the present era, was essentially barbarous. Wars, famine, poverty, and pestilence were the natural order. The great mass of the people were little better than slaves, their bodies to secular and their minds to ecclesiastical princes—two masters often joined in the same person. Hence, man's intellect was dwarfed by superstition, religious intolerance, and ignorance. Since the chief outlet for talent was centered in the church, secular callings for the few

who were able to rise and to make a choice were at a discount. In cities, streets were narrow, winding, and filthy, and the dwellings were not only ill-adapted for such use, but were often insufficient in number. As late as 1830, 18,000 people in Hamburg lived in cellars, or tunnels, to which daylight never penetrated, and the walls and floors of which were wet and befouled with garbage and human excreta. To go back no further than to the fifteenth century, the Hundred Years War had desolated large areas of Europe. As a result of the Thirty Years War, the population of Germany is said to have fallen from 20,000,000 to 4,000,000. The wars of Frederick the Great left Prussia and Silesia and Saxony impoverished and the populations greatly reduced. The condition of much of France for over 100 years before the Revolution of 1789 was one of impoverishment. Italy and the Low Countries had been repeatedly ravished. Spain, the home of intolerance and of popular ignorance and poverty, was in decline. In Russia and southeastern Europe, tyranny, poverty, and ignorance were even more marked. Such was the continent that faced the wars of the French Revolution and of the Napoleonic era. In no country of Europe, not even in England, had the sanitary improvements and measures of the Romans survived. The minds that planned and the hands that built the great cathedrals at Paris, at Rheims, at Cologne, and elsewhere on the continent, and the Abbey of Westminster and the great English cathedrals, did not reproduce or even keep in repair the sanitary sewers and the pure-water systems of the Roman civilization. Even with the wealth of the church and the cheapness of labor, the time occupied in the erection of the cathedrals was measured by centuries rather than by years. With a few striking exceptions, the relatively small wealth existant was concentrated in the hands of the few—the nobles and the ruling princes—and in the church, and the great mass of the people were in poverty. The middle class, represented largely by organized artisans, merchants, and bankers, was relatively small and the markets were restricted.

The revival and growth of sanitary reforms and systems of public health administration were impossible until the human intellect was unshackled from the chains of antiquity and religious superstition, and the dense ignorance and poverty imposed by secular and ecclesiastical tyranny were in some considerable degree overcome. These chains were first cast off in Italy, France, and England as the result of the growth and development of the spirit of scepticism and of inquiry in the fifteenth, sixteenth, seventeenth, and eighteenth centuries which brought about religious and political freedom, enormous expansion of knowledge, and the production and accumulation of wealth.

The wonderful outburst in certain Italian cities of intellectual freedom, associated also with the gaining of great wealth from art, manufacture, banking, shipping, and other great commercial undertakings, was followed by a revival of interest in public health and the reestablishment of health departments and the development of civic improvements of a sanitary nature. Under constant threat of plague from the Turkish dominions, the maritime cities of Italy developed the modern quarantine system. But, with the loss of trade and the consequent decline of wealth and intellectual culture, and of their diffusion in the population following the development of the ports of northern Europe, and the loss by conquest of the relatively incomplete degree of popular political freedom, public health administration and general sanitary improvements not

only ceased to advance, but lapsed into conditions as primitive as those of Spain, France, and central and northern Europe, and lay dormant until the general sanitary revival of the last quarter of the nineteenth century.

Just as in England after a long struggle, the human intellect first gained a goodly measure of freedom, so England was the first country to produce in numbers distinguished investigators in all branches of knowledge and to attain popular government and considerable wealth, with the general diffusion of both knowledge and wealth among the people. There is ample reason, therefore, why that country should have early taken the first place in Europe in public-health investigation and administration. It was not until the nineteenth century, however, that, even there, conditions were favorable for any considerable progress. Nor is it surprising that people of the same blood, with more personal freedom and a wider diffusion of knowledge among the general population, though with less wealth and a smaller productivity in fields of scientific inquiry, should, in the early history of their municipalities (as in Baltimore), while following very closely the traditions and methods of the mother country, have anticipated the English in municipal health legislation and in the establishment of boards of health with medical officers. It is not strange that, so long as few striking contributions were made to general and to medical knowledge and until wealth was accumulated and became more generally diffused, American municipal public-health administration should have, in many respects, lagged behind that of England. A notable point of difference was dependent upon the fact that the early advances made in England were in large degree due to the researches and methods inaugurated and supported by the General Government, while in America the influence of the central and State Governments was, until recent years, practically *nihil*. The backwardness of public-health administration and general sanitation in French municipalities, until comparatively recently, was doubtless due in great part to the struggles to obtain political freedom and to obtain wealth. Napoleon I, however despotic in some respects, in the main adhered to the basic principles of the saner Revolutionists and preserved to the French people the freedom they had gained. He not only fostered science and education, but besides other great improvements, drained large areas of France and in Paris constructed a new water-supply system and numerous sewers. German municipalities were notoriously lacking in these respects until the increase in prosperity and in popular education and the acquirement and exercise of a greater degree of local self-government some years after the Franco-Prussian War of 1870. Even in that country sanitary progress began in the free cities of Hamburg and Frankfort.

Under autocratic governments, the ruling classes are indifferent to distress, disease, and death among the poorer and more ignorant classes, and these people are comparatively helpless, partly on account of superstition and partly on account of their ignorance concerning measures that would improve their condition and their lack of power to extort them. Their ignorance has no doubt been influenced in some degree by the very diseases under which they labored. Autocratic governments do not inaugurate measures for the protection of the general population against disease until a stage of enlightened self-interest is attained, or until the demands for reforms become so loud and threatening that some concession is made. When these conditions obtain,

popular government is in sight. Great and rapid advances in public-health administration and practice have come in modern times from peoples with wealth and with popular governments. Under autocratic governments, knowledge and wealth and a free spirit of inquiry have rarely, if ever, been diffused among the general population.

In free governments, as in American cities, with all classes, and average citizens in particular, jealous of private rights of both property and person, citizens are loath to pass laws of a restrictive nature and are intolerant of restrictive measures imposed upon them by elective or appointive officials. Indeed, they reserve the right to have all laws and regulations submitted through their courts to tests not only of constitutionality, but of reasonableness. It is not until the average citizen has acquired a degree of information through which he becomes convinced that such measures are not only reasonable, but that they will tend to act to the advantage rather than to the disadvantage of himself and his dependents, that he will consent to impose the restrictions involved. Even those measures, the wisdom of which he is convinced, are often postponed, or, if undertaken, are, on account of the cost, prosecuted in a half-way manner. After the citizens have consented to a course, their instruments, to whom are committed the framing of necessary laws and regulations and their administration, and the planning and construction of necessary works and buildings, may, and only too often do, lack in the knowledge, judgment, and efficiency necessary for success. There is a wide gap between recorded knowledge, both general and particular, in connection with any subject and the proportion of knowledge on that subject possessed by those to whom fall the opportunity and responsibility to apply it to popular use.

It is evident, therefore, that to attain a high degree of efficiency in the control of disease, a people must have obtained a considerable amount of knowledge, freedom, and wealth and to be able to obtain health officials with comprehensive and accurate information concerning both the natural history of diseases and the fundamental and applied sciences. These several conditions, necessarily precedent to successful efforts to control the incidence of disease, have never fallen together in Baltimore (nor in any other municipality for that matter), as will be abundantly shown in succeeding chapters. It will suffice to point out here that the failures are to be laid to both public and officials. For over 100 years the needs in connection with general measures outstripped in growth both the intelligence and the wealth of the population, and, until the present time, the general officials often, and the chief health officials nearly always, were so fettered by ignorance and so swathed in the bands of tradition that at critical times the former were incapable of demanding and the latter were incapable of creating a fully rounded health department.

The peoples whom the end of the eighteenth and the first half of the nineteenth centuries found with liberal institutions, after heavy struggles, were busy consolidating and extending their gains. The mere possession of methods was not sufficient in itself among peoples not ready to use them routinely and logically. It is a striking fact that man, although he had formulated long years before the beginning of the nineteenth century practically the same methods of control that he now uses against most, at least, of the typically contactive diseases, has been much more willing to attack the nuisance or effluvial

diseases. His actions in this respect were probably determined by several considerations. In the first place, the necessary measures were directed to things rather than to persons, and therefore violated to a lesser degree his inherent sense of personal liberty and interfered less with his capacity to earn a living. Secondly, after he had acquired knowledge and wealth, and both these attributes had become diffused with a degree of equality hitherto unknown, he developed a sense of decency, a feeling of self-respect and personal pride, a sense of the fitness of things, which resulted in a marked change in manners and customs, both public and private. As a result, conditions of living and surroundings that had previously offended the few were by the end of the eighteenth century distasteful to the many. It is not at all strange that the English, to whom wealth with the power to use it came first, should have been the first as a nation to emerge from the relative barbarity of the sixteenth and seventeenth centuries and to acquire and then to gratify a taste for decency in municipal, household, and personal surroundings, nor is it remarkable that this attitude should be reflected to their descendants in North America. In the third place, efforts to influence the environment promised a richer return than those expended against persons, for they had some striking results to their credit, while on the other hand experience had shown that, so far as attempted, measures to restrict diseases spread especially by personal contact had very generally failed signally.

In the light of these reflections it will not seem remarkable that in Baltimore, as will appear in later chapters, during most of the nineteenth century, the efforts of the health and other civic authorities were directed within the city chiefly against diseases classed as miasmatic, effluvial, or infectious, and that, with the exception of small-pox, the contactive diseases received but scant attention. The sequel has shown that, imperfect and inadequate as were their applications of the measures used, and far short as they fell of what they might have accomplished, the early Baltimoreans took the better of the two bets.

The primary and fundamental steps in the logical application of Mead's recommendations in controlling a given disease are the early recognition and the reporting of all cases to the authorities, and yet it was not until 1889 in London and 1882 in Baltimore that laws were passed requiring routinely the prompt reporting of certain acute febrile diseases. Though in England and Scotland notification of febrile diseases was enforced in a few urban districts as early as 1876, it was not widely adopted before 1882. Prior to the act of 1889, making notification compulsory for all London but optional elsewhere, 17 of the 28 greater towns of England had adopted it and 11 had not. The latter act specified as reportable diseases, cholera, small-pox, scarlatina, typhus, enteric, relapsing, and puerperal fevers, diphtheria, and erysipelas. In Baltimore, the very incomplete list embraced only small-pox, scarlet fever, cholera, yellow fever, malignant diphtheria, and varioloid, all but one of which were then locally regarded as typically contactive in mode of spread, the essential cause of none having been discovered up to that time, and that of only two (cholera in 1883 and diphtheria in 1884) having been conclusively identified up to the present. The other diseases since added to the list by city ordinance are membranous croup, measles, mumps, and whooping-cough in 1890, and typhoid fever in 1895.

It is clear that the earliest of these laws were passed before the discoveries of modern micro-parasitology had begun to exert any direct and controlling influence upon public-health administration. In Baltimore the law of 1882 was passed during the height of one of the most severe epidemics of small-pox the city had experienced. From the evidence at hand it is clear that this was inspired by an attempt to make small-pox a reportable disease permanently, and advantage was taken of the opportunity to include the other diseases, some of which had been widely epidemic and very fatal a few years before.

Besides those considerations of a general nature, there were others of a more specific character that obviously impeded the development of municipal sanitation and public-health administration in the latter part of the eighteenth and throughout the nineteenth centuries. The most important of these was the very rapid and unprecedented growth of urban populations, due not to excess of births over deaths, but to immigration, either, as was particularly true of Great Britain, a migration from country and village to cities, or, as in North America, an immigration from abroad as well as from the above-mentioned sources. These new elements were disturbing factors in many ways. Influenced by a lively sense of self-interest and lacking, at least in the beginning, a personal sense of civic loyalty and responsibility engendered by continuous residence and by generations of family associations and traditions, their presence and activities upset the homogeneity of the population in customs of social and business life, in kinds and directions of trade and manufacture, in education, in politics, and often in religion. Especially disturbing in these ways were, of necessity, emigrants from foreign countries, on account of the wide divergences of customs and prejudices, and above all on account of differences in speech. A large proportion of all immigrants to cities, whether from the same or foreign countries, were deficient in education and training and were poor in purse. Some at once, and many more with even slight adversities in business and trade, became burdens upon the cities. Their mere presence diverted work from old to new channels, and particularly in times of business boom, stimulated building, increased the cost of living, and in other ways upset the balance of life. They caused overcrowding in dwellings, added to the cost of the removal of waste, and their presence resulted in the construction of dwellings at a rate that far outstripped the growth of paving, sewers, and water supplies. Thus, there have so often resulted cities more or less solidly built up in the central area, with durable and well-constructed pavements, surface water and sanitary sewers, and a generous water-supply, bordered by a second area, with poorly paved or unpaved streets, with sewers and water-pipes but incompletely extended, and with conditions of general sanitation varying in its different parts from a semi-urban to a village state. Beyond this there is a larger or smaller zone, with scattered villages or in a partly cultivated rural state, where the general sanitation is of the crudest type. Parts or all of this zone are finally annexed. It not infrequently happens, therefore, that in a North American city under the influence of rapid growth in population, more than half the territory and a third or more of the population are without the area having complete sanitary arrangements in regard to paving, sewerage, water, and garbage removal. Even when the money can be raised to furnish sanitary necessities, the work occupies years, and before it is

completed another annexation takes place. It is only within a comparatively short time that parts of the second and third zones have been paved, sewered, and watered by the owners as development takes place. Migrants, particularly from other countries or distant parts of the same country, have often brought in and kept alive diseases that were dying out, or have imported a disease in more virulent type. Well-known examples are the importation of typhus into Scotch and English cities by Irish immigrants, and the importation of typhus, small-pox, measles, scarlatina, and other diseases into Baltimore by Irish and German immigrants.

Thus it is that, with few exceptions, very rapid growth in population and territory must react unfavorably upon both general sanitation and personal hygiene in a city. In Baltimore the action of all these factors has been particularly striking.

The great influence of the application of statistical methods to the study of the natural history of disease and the problems of public-health administration has also been either overlooked or not duly appreciated. Used first in these connections in the construction of life tables as a basis of insurance, these methods were then applied by publicists and statesmen in determining the laws which govern the growth of population and wealth; by pathological anatomists in the study of the comparative frequency of diseases and of particular lesions; by clinicians, especially the French, in the determination of case fatality rates in different diseases, particularly where certain methods or plans of treatment were concerned; and later by medical men, general statisticians, and public-health administrators in the comparison of salubrity of climate and general environment upon, first, general morbidity and mortality, and, second, particular diseases. Shortly after the middle of the nineteenth century, under the influence of William Farr and his pupils in England, and of Lemuel Shattuck of Boston and of Joynes and Frick of Baltimore in the United States, statistical methods had become a determining force in the study of the natural history of individual diseases and in the whole field of public-health inquiry and administration. The appreciation of statistical methods was not only responsible for discoveries of fundamental importance in these fields, but for the important means of diffusion among people of the knowledge acquired.

Thus it was, largely at least, a coincidence that the discoveries of modern micro-parasitology and the additional practical methods of disease control derived from them fell at a time when a large and the most intelligent part of mankind was ready to consider and to apply them. With certain notable exceptions these discoveries were not made by public-health officials, who have on the whole, but very clumsily, slowly, and reluctantly, applied them. However, instances are not lacking, in the history of Baltimore in particular, of examples of health officials pleading in vain for means and power to undertake measures certain to exert a favorable influence on the public health.

The coincidence of the recognition on the part of the general public of the importance of public-health measures of a wider scope, and the availability of funds to carry them out, with the great discoveries in micro-parasitology, medicine, surgery, and above all in pathological anatomy, during the last third of the nineteenth century, was responsible for the generally prevalent idea that all the knowledge and power of man over the control of diseases are dependent upon them and certain improvements and refinements of methods

arising out of them. Curiously enough, at the same time, some of the labors of previous years began to bear fruit, and, as will be shown later, certain widespread and conspicuous diseases (measles, scarlatina, typhus fever, and smallpox) happened to run into periods of decline, which, for some of them at least, is a phase of their natural history, a fact well established since the days of Sydenham.

Among the many important influences ascribed to modern medical and zoological knowledge has been its effect upon the distribution of the febrile diseases among the old classifications, for due to it the number of affections classed under the nuisance diseases has increased at the expense of the list of those classed as spread by immediate contact. This has largely been brought about by the discovery that the causal agents of certain affections, such as typhus and relapsing fevers, sleeping sickness, and the plague are spread by insects acting either as intermediate hosts or as mechanical carriers, the presence of which beings in man's environment is governed by conditions associated with nuisances due to lack of cleanliness. Another advance due to this knowledge was the determination that, as a rule, under natural conditions the causal agents of the nuisance diseases enter the system through the skin or by the mucosa of the gastro-intestinal tract, instead of by the lungs only, as was supposed, and by the evidence furnished in favor of the view that the typical contagious diseases of a general systemic type, the eruptive diseases particularly, such as small-pox and scarlet fever, as a class invade the body by the respiratory tract, instead of through the skin, as was often formerly held.

To be classed among the greatest contributions made by pathological anatomy and by micro-parasitology to the knowledge of the natural history of the febrile diseases applicable to public-health administration are the determination of the portals of entry and exit of their causal agents to and from the body and their modes and channels of travel within the body; the characters and varieties of lesions produced, particularly those determining a fatal issue; the forces and factors concerned in recovery and particularly in immunity; the identity of various diseases common to both man and lower animals; the separation on an etiological basis of the different affections characterized by the same or similar clinical symptoms or anatomical changes; and, finally, a series of methods for both diagnosis and preventive inoculation based upon pathological anatomy, direct microscopy, cultivation, animal experiment, and immunity reactions.

The application of the methods of chemistry, bacteriology, and zoology to sanitary engineering, and especially to standards of purity of water and of milk and other foods, are of the greatest importance.

This knowledge in these various fields but slowly penetrated the minds of public-health administrators, and these methods came into use in health departments sparingly between 1890 and 1900, more generally in the next decennium, and can hardly be considered to have exercised a controlling influence on public-health administration in Baltimore or in the average municipality before 1910. Indeed, it would be difficult to select another branch of municipal government on which scientific discoveries of corresponding importance could have exerted in so leisurely a manner an influence proportionate to their value

It has been shown that long before the discoveries of modern micro-parasitology man possessed means and methods capable of being used to effect

considerable control over the febrile diseases; that the placing of the old germ theory of the causation of these diseases upon a firm scientific basis was not the essential or determining cause of the modern advances in public-health activities, and that this practice, as regards the contagious diseases, begun in the fourteenth century in Italy, was transplanted to England in the early eighteenth century, and that in England and elsewhere, particularly in the United States, during the latter part of the eighteenth and the whole of the nineteenth centuries, municipalities attacked the effluvial or nuisance diseases with considerable success, and that the contactive diseases in general have, on the whole, been attacked with a much smaller degree of success than the nuisance diseases. A consideration of general history and of the knowledge of the natural history of the febrile diseases indicates conclusively that until modern man had regained his intellectual freedom, out of which sprang religious and political freedom and wealth, advances in public-health administration were, and in the nature of things could be, but slight, and significant progress in the control of these diseases became possible only when in the latter half of the nineteenth century knowledge and wealth were not only attained but diffused. Hence the following generalizations are warranted:

1. The change in man's attitude toward the control of those diseases was the direct result of the revolution in the religious, political, educational, and social status of the common man, proceeding from intellectual freedom, and the effects achieved were due more to the release from inhibitions against the use of existing ideas and methods than to the sudden acquirement of new ones, and, being greatest among peoples who had attained this freedom in the highest degree, were, in any particular place, other things being equal, in direct proportion to the degree of freedom obtaining.

2. There is a direct relation between the diffusion of knowledge and wealth among peoples and their public-health activities, and the discoveries resulting in new ideas and methods applicable to disease control and proceeding from intellectual activities along general and special lines in consequence of intellectual freedom have been submitted to practical application earliest and in the highest degree among peoples with the widest distribution of knowledge and wealth.

3. It is because the methods of control applicable to them are more impersonal (involve to a much less extent intimate supervision and restriction of the person and of personal activities) and because they can be so markedly influenced by measures so largely covered by the expenditure of money upon environment, that the diseases formerly attributed to effluvia, or the nuisance diseases, including those now known to be spread by intermediate hosts, have been and are yet more energetically attacked and more successfully combated than the diseases classed as contagious. Such control as has been attempted over diseases believed to be spread by contact has been determined more by horror inspired by the physical deformities or the mode of death characteristic of a disease than by its fatality. The attempts to control the former class of diseases by prevention and abatement of nuisances were logical and in the right direction, and the failure to secure better results was due in greater degree to lack of effective action on conclusions reached than to defects in the premises set up on assumptions and the deductions drawn therefrom. The one-sidedness in the activities of public-health administration in concen-

trating attention so closely during the nineteenth century upon the nuisance diseases is responsible for the present widespread and deeply rooted belief, on the part of both the public and their administrative officials, that all febrile diseases can be effectively controlled by modifications of environment.

4. As the methods of substitution inoculation against small-pox were known and practiced long before, and as the prevention of wound infection, including puerperal fever, depends so much more upon measures directed to things and to the control of the acts of personal attendants than upon control of persons affected, it may be accepted as an established fact that, with the exception of a few acute diseases for which they have furnished methods of early diagnosis and of preventive inoculation, such as diphtheria, meningitis, and hydrophobia, modern medical discoveries, including those of micro-parasitology, have exercised as yet no fundamentally important influence upon the control of the diseases classed as contagious, for any recently favorable fluctuations in their incidence and mortality can be adequately explained by other factors.

5. As modernly acquired knowledge has, for the control of the mass of diseases classed as contagious, added as yet comparatively little *in principle* to Mead's recommendations, it is evident that in respect to them the only change introduced in public health practice in recent times is the attempt to apply these measures in a more thorough and systematic manner. Though it has been possible under very favorable circumstances to check small outbreaks by their use, or here and there, under ordinary conditions, to restrict the numbers attacked, rarely, if ever, with the exceptions above noted, have any of the diseases classed as typically contagious been curbed when in epidemic cycle.

It is to be clearly understood that, in connection with the foregoing statements, there is no intent to disparage in any way the remarkable and profoundly important discoveries in modern medicine and in the fundamental sciences, particularly in mathematics, physics, chemistry, zoology, and botany, on which it depends, and in the applied sciences of engineering, statistics, genetics, and so forth, on which our knowledge of the natural history of diseases is so largely based and to which public-health administration owes so much, and in all of which discoveries have been gained for knowledge by a comparatively small band of self-sacrificing, devoted, and often brilliant workers, laboring only too often under unbelievable handicaps. No one who has grown up under the influence of this rapid unfolding of scientific knowledge, the most precious possession of man, especially in the biological sciences, during the last 40 years, or who has taken even a small part in its development, can fail to appreciate its importance and significance both generally and in the fields of the natural history of disease and of the development and administration of public-health measures.

To point out that it was not, as was erroneously supposed in many quarters, the acquisition of a particular branch of this knowledge, but the possession and diffusion of knowledge previously gained, to which recent interest and progress in public-health activities are to be attributed is not to deny its great value. The sloth with which modern medical knowledge, and especially micro-parasitology, has been utilized is the result of the lack of proper appreciation by peoples and their representatives, and in no way reflects upon its intrinsic value.

Without the firm standing-ground of the exact scientific knowledge gained in this period, it would not be possible to recognize that previous generations possessed powerful weapons for the control of certain diseases or to appreciate how signally they fell short of their full use, nor, on the other hand, could a just estimate be had of how much was accomplished by the application of methods, sound in many respects, but based upon theories exploded by this knowledge.

The diseases classed by the health authorities and by the physicians generally, in Baltimore, from the earliest times until the last decade of the nineteenth century as infectious, miasmatic, or effluvial, and therefore as nuisance diseases, were malarial and yellow fevers, membranous croup and malignant sore throat (diphtheria), and the diarrhœal diseases, including dysentery, cholera asiatica, cholera morbus, cholera infantum, simple diarrhœa, and typhoid fever.

Among the typically contagious diseases were included small-pox and varioloid, vaccinia, scarlatina, measles, whooping-cough, mumps, erysipelas, typhus fever, influenza, pulmonary tuberculosis, leprosy, hydrophobia, meningitis, poliomyelitis, and the venereal diseases. Tetanus, though not made reportable, was included by inference during the time of its greatest recorded prevalence among the diseases influenced by accident. Diphtheria, by consensus of opinion, was transferred from the nuisance to the contagious diseases during the ninth decade of the nineteenth century. It was not until well after 1890 that such diseases of rare occurrence as anthrax, glanders, actinomycosis, and trichinosis were recognized in the department.

The idea that some of these diseases may be spread in any one of several ways, obvious as it seems, did not occur to the authorities until comparatively recent times, and then only very gradually.

So firmly is the division of the febrile diseases fixed and interwoven into these two distinct classes in the conceptions and methods of the health and other departments of the Baltimore City government, that any complete study of the methods and results of its public-health administration must be based primarily upon them. Therefore, the study of the administrative efforts of the Baltimore City government to control febrile diseases within the city must embrace: (1) measures of nuisance prevention and abatement directed against nuisance-borne diseases, and (2) measures of restriction and inoculation directed against contagious diseases.

MEASURES OF NUISANCE PREVENTION AND ABATEMENT DIRECTED AGAINST NUISANCE-BORNE DISEASES.

The term *nuisance,* as here used, includes all those conditions hurtful or injurious to health, which originate or propagate in man's environment. Nuisances in this sense are of two broad classes: Those inherent in the physical characteristics of a place and those brought about by man's own acts or negligence. Examples of the first class, which may be properly styled nuisances of location, include marshes, ponds, streams, and ravines. Nuisances of the second class fall into five categories: Those due to artificial changes in the contour of the surface of the ground, which interfere with the natural flow of water

and favor the accumulation of dirt (brought about generally by excavations, changes in grades, dams, and irregularities of street surfaces, and so forth); those arising from imperfect methods of disposal of organic waste materials (such as the excreta, in the broadest sense, of man and domestic animals, garbage, offal, street sweepings, and lack of cleanliness of persons and of clothes, by which food, drink, and air are contaminated, or in which lower organisms capable of acting as carriers of pathogenic micro-organisms are bred and supported); those concerned directly with foods (decayed foods, foods from diseased animals or plants, and foods inadequate in themselves); those associated with buildings in which man works or lives; and, finally, those connected with the things with which man works.

Nuisances of either class may be present upon either public or private domains. In Baltimore the topography of the location not only gave rise to numerous nuisances of the first class, but rendered the prevention and abatement of nuisances of the second class both difficult and expensive. Had the town been located on the high ground and grown toward the water, or had the whole area been graded in the beginning for the laying out of a large city, its nuisance problems would have been comparatively simple and its whole sanitary history would have been different. As it is, the town was planted on low grounds, it was bordered on three sides by marshes, through which flowed streams subject to overflow, and on the fourth side it was overlooked by hills separated by ravines. Since the low ground was settled first, only part of the material obtained in grading the hills was utilizable for filling the low-lying section, through or over which the surface water had to flow. The work of grading both sections and of filling and raising the lower portion of the city along the water-front and the four streams was expensive and difficult. In the nature of the case, the problems could be worked out only slowly. It is clear that the main questions presented embraced an abundant and safe water-supply; the collection and diversion of the flow of all household waste, including excreta, to the southeast; grading, filling, and paving; the construction of conduits to lead surface-water to the water-front and to prevent standing water; the removal and disposal of garbage, ashes, and other waste; and the development and practice of decent household and municipal housekeeping. The remainder is simple. None of these matters has ever been brought to completion, and the whole history of nuisance control represents a series of disconnected, bungling efforts to attain an impossible goal. In actual practice these efforts were directed simultaneously against both classes of nuisances, and the only clear-cut division of nuisances, from the standpoint of administration, is into nuisances on public and nuisances on private domains. Even here there is some overlapping. As closely as circumstances will allow, nuisances, however arising, will be considered under these two headings.

I. PREVENTION AND ABATEMENT OF NUISANCES ON PUBLIC PROPERTY.

DREDGING AND FILLING.

The dredging of the basin and the mouths of the main streams, especially Jones Falls and Harford Run, has been executed in general by the city commissioners, the port wardens, or the harbor board. To these authorities also

has fallen, in the main, the duty of filling the marshes, particularly those bordering on these two streams, and for this the dredged material has largely been used. Similarly, authorities other than the Health Department have had charge of sewer building, and the walling in and the covering of the four streams. The health authorities, so long as they were responsible for the disposal of ashes and rubbish, used these for filling in low grounds on public as well as on private domains.

GRADING AND PAVING.

On account of the topography of Baltimore, the amount of grading necessary in the laying out of streets and the filling of low grounds was considerable. In the early days of the city's growth, the filling in of the marshy land along the water-front, especially bordering the course of the four streams, Harford Run, Jones Falls, and Schroeder's and Chatsworth's Runs, comprised the chief grading activities. Much of the material for this purpose was dredged from the basin and the mouths of the streams. Later, with the growth of the city to the north beyond Saratoga Street, and west and east, a series of high and irregular hills were cut through and smoothed off, and the valleys between them raised. This required an enormous amount of labor. The margin of the built-up section has always presented a number of ravines to be filled. For this purpose soil obtained from leveling and from the excavations for buildings and, of late years, coal ashes and cinders, have been used. In this way the use of ravines and other low places, with which the border of the city has always abounded, as public dumps, has done away with many nuisances and has been of material assistance in grading.

As early as 1782 the grading and paving of the streets and sidewalks was undertaken in a systematic manner under the direction and control of a special commission established for the purpose by the legislature. At this time, Market or Baltimore Street, the main thoroughfare, was in a deplorable condition and in wet weather was almost impassable. The street pavements, at first confined to the business sections, were of rough cobblestones, set in sand on top of the clay soil. By an ordinance in 1819, all future paving was to be done with river or pebble stone (called cobblestone) from 7 to 3 inches in diameter and at least 5 inches in length, set upright in a bed of sharp sand at least 1 foot in depth. Until 1910, except where Belgian blocks (granite blocks) and occasionally asphalt were substituted in a few business streets and prominent thoroughfares, the typical cobblestone-paved street was elevated in the center and sloped to the sides, which were bordered by gutters laid with smaller and flatter cobblestones. Set in sand over a clay base and with poorly matched stones, these pavements under heavy traffic developed larger and smaller holes in which water and organic materials collected. The private alleys (varying in width from 3 to 18 or 20 feet) which intersect every block were gradually paved with cobblestones in most of the closely built sections of the city. These pavements were concave with a central gutter for the conduct of storm-water and the household wash-water, which poured into it through rough and for the most part open drains which traversed the neighboring backyards. As these pavements were often poorly laid and ill adapted to support the heavy garbage and ash carts that passed through the alleys, they soon became full of holes, in which collected stagnant water, garbage, and stable

manure. In many parts of the city the alleys were catch-basins of filth, for into them were deposited garbage and ashes for collection and all sorts of household rubbish. The condition of the unpaved alleys was worse. The alleys, except when they have occasionally been taken over by the city, are private, belonging to the owners of the adjacent properties along the rear or side of which they run, and, therefore, their paving is at the expense of the owners.

The report of the city engineer in 1911 gave the street mileage of the different kinds of pavements as follows: Cobblestone, 354.82; Belgian block, 43.49; sheet asphalt, 19.23; vitrified brick, 19.15; wooden block, 1.63; ordinary macadam, 56.01; bituminous macadam, 2.73; bitulithic, 10.10; cement surface, 2.01; unpaved 57.73. Thus of the total mileage 62.5 per cent was cobblestone, and of the total mileage of what may properly be called street pavement (excluding the ordinary macadam and the unpaved streets), 78 per cent was cobblestone.

During the early days of the city's history, the sidewalks were largely of brick, retained at the gutter side by a curbing of granite. Of late years, cement has been generally used, and much of the former brick paving has been replaced with this material.

Since 1912, under the stimulus of Mayor James H. Preston and following the construction of the new sewerage system, many miles of streets have been regraded and paved with smooth pavements, edged by well designed and constructed gutters with smooth surfaces.

In 1916 and 1917, all of the nearly 3,000 roughly paved private alleys were condemned as nuisances by the health department and ordered regraded and paved with smooth pavements by the highways engineer at the expense of the owners. When this work was suspended during 1918 on account of the war, this undertaking had been completed in about half of these alleys.

STREET CLEANING AND GARBAGE REMOVAL.

Since the passage of Ordinance 15 in 1797, it has been the duty of the owners or occupiers of houses and lots within the city to keep the sidewalks clean and the gutters clear, and it has been the function of the city government to clean the streets or public highways and to remove the sweepings. The latter duty was exercised under the direction of the city commissioners until 1826, when it was transferred to the commissioners of health. In 1882 it was taken over by a newly created department of the city government, the department of street cleaning.

It is not certain when the removal of garbage and ashes was first undertaken by the city. It is probable, however, that until 1821 each householder made his own arrangements for this purpose, and it is likely that it was fed to pigs within the city. In 1821 the city undertook the removal of garbage and ashes, and the superintendents of street cleaning, offices established in 1798 under the city commissioners, were required by ordinance to collect garbage on three days of each week between May 1 and November 1, and from this time the removal and disposal of garbage and ashes have been conducted under whichever department of the city government was responsible for street cleaning.

In 1826, the commissioners of health let out the cleaning of the streets and the removal of garbage by contract. The total sum appropriated to the health

department for these purposes in 1827 was $3,500. Since 1828, the manure obtained from the streets has been sold, and the income from this source in considerable part paid for the work. Thus, in 1820, of $5,500 available for those services, $1,500 was derived from the sale of manure.

It is related by Wynne that in 1849 the city, for purposes of street cleaning, was divided into five districts, the cleaning of each of which was let to separate contractors. Each contractor received in payment the street refuse, which was sold as manure, and about $1,000 in money.

The streets received attention in proportion to their tendency to collect filth, but never more than twice a week, and more usually once in two weeks. The numerous narrow alleys and courts, inhabited by the poor and the depositories of garbage and worse, received little attention and were generally in a filthy condition. The most effective scavengering in these districts was performed by swine, which roamed through them at pleasure. The most effective street cleaning was performed by the copious showers, which were most frequent in summer.

In 1853, the contract system of the cleaning of streets and the removal of garbage and ashes was abandoned, and these services were taken over by the commissioner of health, Mr. Charles A. Leas, who, judged by his detailed reports and his recommendations, was an engineer of ability. His report of 1853 is the first from which it is possible to form any accurate idea of the amount of work done and of how it was accomplished. In the last nine months of this year there were removed 43,576 cartloads of street sweepings at a net cost, after the sale of the manure, of 14.5 cents a load, and 21,642 loads of garbage at a cost of 43.5 cents a load. The total actual cost to the city, exclusive of sweeping the streets, of the removal of 65,218 loads was $16,586.19. There were 26 carts to remove garbage from 30,000 houses; i. e., each cart had to collect from 1,154 houses, daily in summer and biweekly in winter.

Mr. Leas proposed a permanent garbage-disposal place on a farm owned by the city, which would be served by boats and where the garbage would be fed to pigs. This piggery, he thought, would in a few years yield a return sufficient to pay all the expenses of garbage removal. Unfortunately his plan was not adopted.

A decided step forward was taken in 1876, when householders were required by ordinance to keep garbage and ashes separate, in order that the latter might be used to fill in low places within the city. The garbage and other offal were hauled to convenient lots near the outskirts of the city and placed on large dumps until 1877, when a new policy was adopted of delivering it to contractors, who removed it by rail or by barge to points not less than 6 miles from the city limits. This change of method of removal was forced on the city by threats of suits on the part of the inhabitants of Baltimore County.

In 1880, 26,252 loads of garbage were delivered at the contractors' dumps at Canton and Spring Gardens, and for transporting this the contractors were paid 51.5 cents a load.

Between 1904 and 1919, the garbage so conveyed was "reduced" by contractors, and in the latter year arrangements were made with a contractor to feed the garbage to pigs at a farm fitted for this purpose on the water-front well below the city. Thus after 66 years, Commissioner Leas's plan of garbage disposal, somewhat modified, was adopted.

In 1917, the number of cubic yards of garbage hauled by the city was 113,162; of ashes and refuse, 425,307; of street dirt, 225,224; of sewer and inlet dirt, 13,760; and of snow and ice, 136,542; a total of 913,995. Dead animals removed numbered 20,178.

The work in connection with the control of mosquitoes is set forth in table 4.

TABLE 4.

House inspections	114,414	Toilets reported overflowing or in need of attention	2,220
Breeding-places found and destroyed	3,984	Complaint cards turned in by employees	324
Circulars distributed	115,717	Premises and other unsanitary conditions reported to city departments	3,439
Notices sent out	5,259	Improper garbage cans reported to police department	6,337
House inspectors, daily average	26	Gallons of larvacide solution used	5,855
Men employed, weekly average	285	Gallons of oil solution used	7,176
Pools drained	143	Gallons of kreso used	50
Old ditches cleaned, graded, filled, or oiled, feet	1,144,595		
New ditches constructed, feet	16,133		

The total expenditure of the department for 1917 was $876,093.02, including $25,897.73 spent on the work of mosquito control. From the sale of refuse, $12,729.10 were realized.

SEWERAGE.

Sewerage will be considered under three headings: First, storm-water; second, household water, that is, toilet, wash, and kitchen waste; third, human and animal excreta, slaughter-house waste and other wastes exclusive of garbage.

Until 1915, storm-water and household water were disposed of in the same way, that is, by natural flow into the water-courses traversing the city and ultimately into the harbor, basin, and the middle branch of the Patapsco River. As the city grew and made a large area, which, on account of the houses and street pavements, was impervious to water, the storm-water thus to be disposed of very greatly increased in volume. As a result, the low-lying sections of the city, particularly the narrow valleys, were often flooded, and with the subsidence of the water they were left covered with a large amount of silt and street and household washings, including manure, grease, and garbage. The large rainfall served to keep the higher and hilly sections fairly clean and took much of their dirt to the low-lying portions. For the same reasons, the water-courses, often in a state of flood, would overflow their banks and further add to the filth in the lower, flat portions of the city. The land-locked basin, the harbor, and Spring Gardens, to a lesser extent, thus in the course of time became loaded with organic waste, the putrefaction of which in warm weather gave rise to very offensive odors which were a constant source of annoyance. The same streams, first at their mouths and later throughout their courses within the city, became foul, ill-smelling sewers, giving off offensive gases in hot weather. Of these, the foulest were Jones Falls and Harford Run. The storm-water gutters in the streets and alleys, being rough and irregular and often improperly graded in many places, formed pools of water containing organic material. These were particularly offensive in the narrow courts and alleys of the poorer sections, from which drained every conceivable kind of organic waste and other filth. In 1850 there were about 2 miles of storm-water sewers in the whole city.

The first serious consideration of the sewerage question on the part of the city government was in 1859, when a sewerage commission of three, under the chairmanship of Henry Tyson, was appointed. In its report made in 1862, the commission recommended the establishment of eight sewerage districts in which sewers were to be built to carry off storm-water and household waste-water, exclusive of human excreta, more readily along the natural drainage lines. The commission pointed out that in building the sewers then existing in Baltimore, no particular form or system of size had been adopted and that in but few instances could they be exactly located. They often ran a winding course, the bottoms were nearly always flat; some were floored with plank which had decayed and left the original earth bottom protected from washings only by the accumulation of stone and other heavy substances which had washed into them. Some sewers were roughly paved with stone; in all of them the free flow of water was greatly impeded; and during dry weather the surface-water and house drainage, spread irregularly over the surface, were either absorbed by the earth or evaporated, leaving heavy animal and vegetable substances to decay in the sewers, resulting in offensive effluvia arising from the open and untrapped inlets. In some of the sewers, side walls only had been built to confine the water course, and they were planked over at the street crossings; otherwise, the floors of the houses built over them formed their sole covering. The commission recommended the building of a series of sewers with well constructed and trapped inlets to carry off the house drainage and surface-water from the eight districts above mentioned, and planned to lead the tributary sewers or laterals either into the main water-courses which were to be covered over eventually or through covered sewers directly into the harbor and basin. As this drainage was to go into the harbor and basin, they thought it unwise to include human waste. This they planned to dispose of into the ground in cesspools as before. These recommendations were carried out in part somewhat slowly, and largely under the pressure of the health department for the abatement of nuisances. Harford Run was not covered over until 1885, and Jones Falls was covered over through a part of its course in 1912.

Mr. C. H. Latrobe, C. E., who had been appointed by the city council to report on the best plan for sewerage disposal, rendered an interesting report in August 1881. Recognizing that the subsoil had reached the limit of its capacity to care for human excreta by the cesspool and privy systems, he recommended a dual sewerage system; one for surface-water and rainfall, to discharge as before into the middle branch of the Patapsco, the basin, and the harbor, and the other for household waste and human excreta, to discharge partly into the middle branch of the Patapsco and partly into the lower harbor below Canton. His recommendations for sanitary sewers were entirely passed over and the construction of storm-water sewers was continued along the lines of the plans of the Tyson commission, somewhat modified by the recommendations of Mr. Latrobe.

By 1890, owing to the great increase in the number of cesspools, many of which had been connected to the old and to new storm-water sewers and drained directly into the basin, harbor, and the middle branch of the Patapsco, and to the fact that many of these sewers were improperly trapped, conditions had become much worse. The uncovered Jones Falls was to a great degree a combined storm-water and sanitary sewer, carrying so much filth that it was con-

stantly necessary to dredge its lower portion for the removal of sediments of organic matter. For 40 years or more the sulphuretted hydrogen gas evolved from the sewers and the basin, with favorable wind conditions, reached all parts of the city. Large quantities of sediment of sewer origin were each year dredged from the basin and especially from between the docks and at the sewer outfalls.

A second sewerage commission, under the chairmanship of Mr. Mendes Cohen, was appointed in 1893 and engaged Messrs. Rudolph Hering and Samuel M. Gray as consulting engineers and Mr. Kenneth Allen as assistant engineer. After an exhaustive study, the commission, in its report of September 1897, recommended a dual sewerage system, the storm-water to be discharged as recommended before, and the domestic waste, including human excreta, to be disposed of by dilution into the deep waters of the Chesapeake Bay, well below the city. Of the two alternative methods proposed by the engineers, i. e., chemical precipitation before such discharge and the use of filtration beds on land in Anne Arundel County, they objected to the former as unnecessary and to the latter on account of its great expense.

The city government, fearing injury to the fishing industry, particularly on account of the danger of infecting oysters with typhoid bacilli, directed further investigation and a report on the best alternative plan. The commission then suggested that the plan of land filtration be tried, but be restricted at first to the sewerage from the low-level area, thus serving about one-third of the population. The whole matter was then dropped, because the people refused to approve a bond issue to pay the cost of the work.

In 1905, the third sewerage commission was appointed. Messrs Hering, Gray, and Stearns served as a board of consulting engineers, and Mr. Calvin W. Hendrick was appointed chief engineer. Mr. Hendrick and his staff designed and superintended the building of a double system of sewers—surface-water and sanitary—covering most of the built-up sections of the city. The surface-water sewers discharge the storm-water as before. The sanitary sewers carry domestic waste and human excreta to a point on Back River, to the southeast of the city, where the sewerage is purified and the effluent discharged into the Bay. The system was completed in 1915. Connections were started on a limited scale in the fall of 1911 and practically all of the connectable buildings, over 90,000 in the sewered area, had been connected by 1918.

As has been previously indicated, human waste was disposed of throughout the history of Baltimore until 1915 either by privies, cesspools, or storm-water sewers. As the city grew, the use of privies decreased and the cesspool became the usual method. As a rule, every dwelling had its own cesspool, protected by a house, situated in the back yard. In some of the larger houses there were closets, situated either on back porches or within the houses, leading to cesspools, located either in the yards or under the cellars. At what date water was introduced for flushing such closets in Baltimore is unknown, but in 1849, according to Wynne, this practice obtained in a considerable number of the better class dwellings.

Under the description of the water-supply, allusion is made to the partial protection of the city springs against contamination by privies afforded by the ordinances of 1817 and 1820. To what extent the specifications laid down in the ordinance of 1820 for the construction of water-tight privies in the prox-

imity of the city springs were later generally extended is not known. While there is much evidence that many of the privy-wells or cesspools in connection with the better class of houses throughout the city were well constructed and made water-tight—at least when built—it was not until 1891 that an ordinance was passed requiring that every privy-well or cesspool should be made water-tight. The typical water-tight cesspool had walls 9 inches thick, of brick set in cement, and the outside was well puddled with clay. At one time barrels or hogsheads buried in the ground were used as cesspools. The common practice in certain parts of the city, until forbidden by law in 1906, of connecting several houses with a single cesspool was a frequent cause of overflow. Sanitary nuisances from privy-wells or cesspools arose in several ways. In the first place, many were not properly closed at the top and in consequence emitted disagreeable odors, to which diseases were attributed, and attracted and fed flies, mosquitoes, rats and other vermin. In the second place, on account of neglect or inaccessibility, many were not regularly cleaned, and their contents overflowed into cellars, yards, courts, alleys, and streets. In the third place, although in 1821 it was provided that all privies hereafter constructed on docks, wharves, or made ground, and all other privies within the limits of direct taxation (built-up sections) should be made water-tight, those that were not of water-tight construction originally and those that were water-tight but developed breaks saturated the soil and polluted the springs and wells. As the cesspools were set in a stiff clay soil, much of this material made its way to the surface and thus added to the nuisance from overflow. A large proportion of the cesspools were constantly overflowing into cellars, streets, courts, and alleys, and created a formidable nuisance. The privies and cesspools were cleaned out by night-soil men, who, since 1798, were licensed and in a manner supervised by the health department, but employed at the expense of the householder. This material was hauled away in carts, at first to dumps outside of the city, where it was sold to farmers, and later to scows at Folley's and Winans's wharves, whence it was carried to Bush River and other creeks tributary to the harbor and sold in its raw state to farmers or manufactured into poudrette to be sold as fertilizer. At various times, with and without the permission of the city government, cesspools were connected with the laterals of the storm-water sewers. The chief engineer of the last sewerage commission estimated in 1910 that at that time 15,000 dwellings had been discharging in this way into the basin and harbor. There are now over 90,000 houses connected, and in most of the old 24 wards the privy and the cesspool have been eliminated. Thus, the opportunities for fly-borne typhoid must have been greatly restricted.

Much of the sanitary sewerage of a considerable district in the northwest and southwest sections of the city still finds its way into Gwynn's Falls, a stream already polluted with sewerage before it reaches city limits. As the population so served is still relatively small and the stream is large and rapid, the insanitary conditions are by no means a nuisance comparable to those which obtained in Jones Falls, or in Harford, Chatsworth, and Schroeder's Runs in former days. Jones Falls and its tributaries as well still receive a certain but relatively small amount of sanitary drainage from outlying sections of the city. The same may be said in regard to Herring Run, as it runs through the northeastern part of the city. This stream is already polluted from sources to the north of the city. The closely built up Highlandtown, bounding the

eastern margin of the city, still retains to a large degree the old, primitive method of storm-water and sanitary sewerage disposal which obtained in the old city before the construction of the new sewerage systems.

In review, the storm-water, together with household, laundry, and kitchen waste-water, and fluids from slaughter-houses, stables, and factories, was from the beginning of the town until 1912 very inadequately drained by gutters, through and over the streets, lanes, courts, and alleys, into the basin, harbor, and the middle branch of the Patapsco, either directly or by means of the four streams. After 1860 a considerable, but quite inadequate, number of storm-water sewers removed some of this drainage from the streets. The storm-water also carried a large amount of garbage and street dirt and manure. As the flow was much impeded by the irregular and rough character of the pavements of both streets and alleys, accumulations of water containing organic waste were numerous. Until about 1870, practically all the human waste was received in earth privies or in cesspools or privy wells. After this date a considerably increasing amount of this material was discharged either by private sewers or by connections with the storm-water sewers as they were constructed. By 1910 about 15 per cent of the whole amount was disposed of thus.

In certain sections of the city to which the new sanitary sewerage system does not yet extend i. e., a portion of Locust Point, the outlying sections on the western boundary of the city, some portions of the northwestern section, and most of the Hampden-Woodberry district, old methods of disposal of human excreta are still in vogue. In those portions of the city bordering on the harbor, it is discharged directly into the basin or into the middle branch of the Patapsco; in the western and northwestern sections it is disposed of either into cesspools or into Gwynn's Falls and thence into the middle branch of the Patapsco by connections with storm-water sewers; in the Hampden-Woodberry district, cesspools are still numerous, but a considerable proportion of the human waste is discharged by storm water or by private sanitary sewers—in some cases after crude forms of purification—leading into Jones Falls and thence into the basin. Similarly, on the northeastern side of the city, much of the newly developed section is without sanitary sewers and is served temporarily by connections with storm-water sewers or by private sanitary sewers—both discharging into Harford Run or into Herring Run, and thence into the basin and harbor. The aggregate amount of the material so discharged is not yet sufficient to give rise to disagreeable odors, and as practically all the wells and springs in the old 24 wards have been eliminated, this method of disposal has been no great menace to health. Some years must elapse before the plans of the sewerage division to reach all these areas with sanitary sewers are carried out.

Throughout the history of the city until the completion of the new sewerage system, the overflowing privy and the disposal of night-soil were constant nuisances. As in the annexation of 1888, so with that of 1919, the city annexed a large territory, much of which is without sanitary sewers.

From the building of the first sewers to the completion of the new sewerage system, the health department was charged with the sanitary supervision of the sewers and was responsible for cleaning and for the removal of obstructions. In recent years the care of the traps of the storm-water sewers has been a duty of the street cleaning department, and the whole care of the sanitary sewers

from the disposal plant to the lines of private property has rested with the sewerage division of the city engineers' department. The jurisdiction of the health department over both storm and sanitary drainage begins with the private property lines and, within these, remains absolute.

WATER.

Until 1808, the water-supply of Baltimore was almost entirely of intra-urban origin and was derived from springs and wells and perhaps, to a small extent, from the creeks and runs traversing the territory from north to south and emptying into the harbor, the basin, and the middle branch of the Patapsco River. In all parts of the city, including Old Town and Fell's Point, natural springs abounded. As the town and city grew, many of these springs became no longer available, due to the encroachment of buildings. The earliest spring now known to have been in general use was the Cool Spring, pictured in Moale's sketch of Baltimore Town (1752), situated near the western bank of the basin. It played a large part in the life of early Baltimore, both as a place of social rendezvous and a source of water for townspeople and for ships. It was perhaps the same spring as the one later known as Clopper's. Some of the larger springs were reserved and improved for public use, being surrounded by small parks or squares and covered with attractive "spring-houses," which were supported by pillars and ornamented with balustrades. The most famous of these were the Eastern, Western, Center, and the City Fountains. The Eastern Fountain was situated near the corner of East Pratt and South Eden Streets, and it was supplied with water from a local spring, probably Sterritt's Spring, purchased by the city in 1816. The fine spring-house with Ionic columns was finished in 1819. The Western Fountain, situated at Charles and Camden Streets, was supplied by pipes leading from Clopper's Spring, several squares distant, at the edge of the basin. The spring was purchased by the city in 1816, and the fountain or spring-house was completed some years later. Clopper, who had owned the spring, supplied vessels with water at a neighboring dock. As late as 1832, surplus water from this spring was led by underground pipes to a wharf on Light Street. The Center Fountain, in Marsh Market, furnished an abundant supply of water piped down from a spring situated in the hill, near the present Center Street, in the park surrounding John Eager Howard's residence, Belvedere. It was written (2) of this spring in 1832:

> "It enjoys the best reputation of all the fountains. As it springs from the base of a hill in a neighborhood in which there are few dwellings, it is considered of less equivocal origin than is occasionally imputed to the other three; and inasmuch as the virtues of filtering water are not possessed by the soil of Baltimore—at least in the public estimation—the Center Fountain, which requires no purification, is the most esteemed by the water drinkers of this day."

The City Fountain, or Spring House, situated at or near the corner of the present Calvert and Saratoga streets, was erected after the purchase of the property by the city in 1808, about the time when Calvert Street was opened at this point. It derived its water from several springs, which had long been in use and which sprang from the sides of the hills that overhung the original course of Jones Falls at this point.

That the authorities were at an early date sensible of the danger of pollution of public and private springs and wells is clear from the ordinances, in regard to the location and construction of privies, passed in 1817, 1820, and 1821. As these ordinances provided that privy-wells to be constructed in the future should be water-tight and that only such old privy-wells or vaults as were on docks, wharves, or in made ground, or which, in the opinion of the health authorities, might corrupt the Eastern or Western Fountains, were to be of this type, and as they especially exempted privies situated without the limits of direct taxation—the "precincts"—estimated in 1816 to include 16,000 inhabitants, it is clear that they failed to safeguard adequately the waters of springs and wells within the city. The enforcement of these ordinances was doubtless responsible for diminishing, or, as on low grounds, for actually eliminating some water pollution, but in general they did not cover at least the greater part of the old privies.

Before this time and later there were great numbers of private and public wells scattered throughout all parts of the city. Beginning in 1797, the city authorities would dig a well and erect a pump anywhere on petition of eight householders residing in the vicinity of the proposed pump. These wells were particularly numerous in the closely built sections of Fell's Point and in that part of the city west of Jones Falls and near the basin, in which places they were most open to pollution both from the surface and through the soil. In 1798 a superintendent was appointed for each ward to see that the wells and pumps were kept clean and in good repair. In 1803 two superintendents were appointed to supervise the sinking of wells and the erection of pumps within the city. According to Wynne, in 1849 the pump (well) water was offensive to the taste and decidedly hard, and it was seldom used by those who could obtain a supply from the water company; but, as will appear later, this supply was then available certainly for not more than a third and probably not more than a fourth of the population.

In the very nature of things this intra-urban water-supply, drawn from sources necessarily contaminated with human excreta deposited in the ground in cesspools or on the ground in surface privies, both nearby, became grossly polluted at an early date in the history of the town and city. Between 1790 and 1860, with the extraordinarily rapid growth of a closely built city, conditions conspired to increase the degree of this pollution. Long after a general water-supply became available to most of the inhabitants, many held tenaciously to springs and wells for their drinking water. Within the memory of those not yet of middle age, many people, even in the wealthiest sections of the city, preferred to drink water from nearby pumps, some of which enjoyed considerable local fame.

As early as 1792, the legislature granted permission to a fire insurance company to organize the Baltimore Water Company, with the privilege of supplying water to private users, but this privilege was not exercised. In February 1799, the city council authorized a commission, of which the mayor was a member, to contract for a public water-supply to be obtained from either Gwynn's Falls, Jones Falls, or Herring Run and distributed to the different parts of the city. This came to naught, probably because authority had not been first obtained from the legislature. These powers were obtained in 1800,

and in 1803 the city government appointed a commission to examine creeks and streams within 10 miles of the city and to select one for a copious and permanent supply of "wholesome water."

When nothing tangible had been accomplished, owing to delays on the part of the city government, a public meeting was held on April 21, 1804, at which a committee of prominent citizens, including John Eager Howard, was appointed, under the chairmanship of General Samuel Smith, to organize a stock company for this purpose. Apparently the motive of the organizers was not profit based in any degree upon privilege, but a patriotic desire to insure an ample supply of a necessity for health and for fire protection. The Baltimore Water Company was formally organized on May 24, 1804, and on February 14, 1806, it was granted powers to lay pipes and to convey water under and along the streets, lanes, and alleys of the city.

At Fell's Point, where the ground was low and abounded in marshes, much of which had to be filled in and was therefore particularly unsuited for wells, and nearby hills, from which spring-water could be conveniently drawn, were lacking, the demand for an external water-supply was more insistent than in that part of the city lying west of Jones Falls. In a small area there was a considerable population, and here, too, owing to the fact that vessels of deep draft and long voyages docked, the demand for water for ships was great at Fell's Point. It is not surprising, then, that on March 26, 1804, the city government granted to John O'Donnell, a member of the water commission of 1799, and others the rights to conduct water "through proper pipes" from a "spring near the Harford Road" to supply themselves and tenants of houses fronting on Market Space and neighboring wharves and appropriated a piece of ground on the market space for a reservoir, nor that in 1808, Joseph and James Biays sought and obtained the rights to convey water by pipes under the streets, lanes, and alleys of Fell's Point. How far these projects were carried is not certain, but it is probable that they were merged into those of the Baltimore Company.

After much discussion, Jones Falls, the most convenient stream, was chosen as the source of supply for the Baltimore Water Company. A reservoir was constructed on the high ground at the intersection of the present Cathedral and Franklin Streets, a point well outside of and overlooking the young city. Pumps driven by a water wheel and located near the present site of the Calvert Street Station on Jones Falls, due east of the reservoir, forced water into the reservoir from the common mill-race of Kellar's Dam, which supplied power for the Salisbury Mill, situated near the old Belvedere Bridge. This mill-dam, located just east of the site of the present Guilford Avenue Bridge, was well above all city habitations, including those in Old Town, which marked the highest limit of the built up section at that time. Soon after this time the company erected a second pumping-station (later with steam pumps in reserve) near the Belvedere Bridge, and, in 1838, constructed an additional reservoir, with a capacity of 3,000,000 gallons, near the intersection of the present Chase and Charles Streets. A third reservoir, the old Mount Vernon Reservoir, with a capacity of 15,000,000 gallons, was built in 1846 near the present site of the Pennsylvania Railroad Station on North Charles Street and was supplied with water by natural flow from the dam of the Lanvale Cotton Mill, situated some little distance above on Jones Falls.

All the original water-mains and service-pipes were made of wood. The former were of hemlock logs about 8 feet long, with bores of from 1½ to 4 inches in diameter. One end of each log being trimmed to the shape of a spigot and the other end being bored to a bell-shape, the joints were made by driving the spigoted end of one log into the bell-shaped end of its mate and securing them by a wrought-iron band. The main valves were of cast iron with tapering spigot ends which were driven into the wooden mains. The valves were opened by lifting the valve-plugs with hooks. The service-pipes were of cedar logs about 6 feet long and 6 inches in diameter, with bores of 1 inch. They were connected to the mains by means of tapering ferrules of brass. These log mains and service pipes have been dug up in nearly all the old streets near the water-front in the Fell's Point section, as well as in the district represented by the original Baltimore Town, to the west of Jones Falls.

It is not improbable that the water, in passing through those wooden pipes, was frequently contaminated by the seepage through cracks and joints from the polluted soil in which the pipes were laid. In the report of the sewerage commission for 1910 there is a photograph of some wooden water pipes "about one hundred years old, found in the sewer trench in Exeter Street, between Lexington Street and Necessity Alley." These logs, evidently belonging to a very large main, were apparently not connected as in the above description, which is taken from Mr. Quick, for there is no evidence of bell-shaped and spigot-shaped ends. Judging from the photograph, they were probably joined by metal sleeves, either fitted into the bore or sunk into the peripheral part of the logs. In the nearest log in the photograph there is a large longitudinal crack, extending from the lumen to the surface. It seems probable that, with the varying pressure in such pipes, there was not only considerable leakage, but, on occasions and under favorable conditions, seepage of polluted ground-water into the water system. It is stated by Wynne, writing in 1849, that after 1820 all the new mains were of iron and the new service pipes were of lead. The water-mains at this time varied from 3 to 18 inches in diameter.

The new water-supply became available for household, fire, and general purposes in 1808, when the population of the city was about 40,000; but, since it was generally extended only into such sections as would pay interest on the expenditure, the water was used by a relatively small part of the population for potable purposes. As late as 1849, according to Wynne, the mains were laid in only about one-half the populated portion of the city, and about 5,000 houses were supplied with hydrants with unlimited use of water. Since the population was about 160,000 at this time and most of the houses were small—the greater number being two stories high and many only one—it is evident that even at this late date certainly not over one-third and probably not over one-fourth of the inhabitants were furnished with this water-supply. There were, however, some free hydrants paid for by the city for the use of the poor. The charges for the use of water by private families were $10 per annum for houses over 17 feet front, $8 per annum for houses under 17 feet front, and $3 per annum extra for each bath and water closet. The daily consumption of water (including 150 fire-plugs) was from 500,000 to 1,000,000 gallons in summer and much less in winter.

In the early days this water was subject to some contamination from the privies of Towson, of the few settlements about the mills on Jones Falls and

its tributaries, and of the farms on the water-shed. To what degree the country-side had become infected from the city is unknown, but it is probable that the infection was not great before 1850. In 1851, according to T. H. Buckler, from 2,000 to 3,000 people lived on this water-shed within 4 miles of the city. The water was muddy, because the adjacent land was under cultivation, and offensive, because of the large quantities of organic matter in the shape of barnyard manure and poudrette put on the soil.

It would appear that the city government was not satisfied with the water-supply, for Mr. John Randall, jr., made an official report to the city authorities in 1836, in which, after a survey of all the eligible streams in the neighborhood of the city, he recommended the Great Gunpowder Falls as the best source. He estimated that this would furnish 65,000,000 gallons of water every 24 hours in the dry season. He proposed that a dam be built at Tyson's Mills on the Gunpowder River and another on Western Run, with a connecting aqueduct constructed across the valley of Beaver Dam, passing to the limestone ridge between Cockeysville and a point near Timonium and separating the Gunpowder and the Jones Falls water-sheds. From this point the water was to be carried by an aqueduct passing through this ridge and thence along the valley of Jones Falls Creek to a large reservoir near the city, with an elevation of 300 feet above mean tide. The matter did not go further at this time.

In 1849, Wynne described the Jones Falls water-supply as pure, sweet, and soft, while T. H. Buckler, writing in 1874 (42), pictured it as muddy and offensive to both taste and smell at times in the summer. Buckler, about this time, urged the substitution of the Gunpowder for the Jones Falls water-supply.

In 1854 the city acquired the property of the Baltimore Water Company. The supply of water derived from the then existing dams on Jones Falls being inadequate, the question of a choice of a new water-supply came to the fore again. After a sharp discussion of the relative merits of Jones Falls and the Gunpowder River as sources of a new water-supply, the contest was decided in favor of the former. By means of a dam at Relay Station on the Northern Central Railroad, an impounding reservoir was made called Lake Roland, with an elevation of 220 feet above mean tide and an available capacity of 400,000,000 gallons. From this, by means of a tunnel 4 miles long, water was led to two new reservoirs, one at Hampden, with a storage capacity of 50,000,000 gallons, and a second, the present Mount Royal, with a storage capacity of 30,000,000 gallons. The system was put into use in 1862. The consumption of water was not over 8,000,000 gallons a day, and the daily available supply was estimated at not under 20,000,000 gallons.

In 1870 the present Druid Hill Lake, in Druid Hill Park, with a storage capacity of 429,000,000 gallons, was completed. The west high-service reservoir in Druid Hill Park, with an elevation of 320 feet above mean tide, was finished 4 years later. In the 8 years between the acquirement of the water-works by the city in 1854 and the coming into use of the new water-supply in 1862, the contamination of the water shed must have become much more serious. During the Civil War Baltimore was not only a great center for the collection and distribution of Federal troops, but for large and numerous military hospitals. Through the city passed great numbers of soldiers going to and coming from the armies of the Potomac, West Virginia, Kentucky, and

Tennessee, and to the city were sent not only the wounded, but the sick of armies notoriously heavily infected with typhoid fever, diarrhœa, dysentery, and malaria. It is probable that these soldiers spread these diseases by all possible means in the city and in the suburbs.

It became evident in 1872, a year of exceeding drought and consequent water famine, that the water-supply would have to be reinforced. As a temporary expedient, a dam was constructed at Merideth's Ford on the Gunpowder River, and 5,000,000 gallons of water were pumped daily through a main over the dividing ridge between the Gunpowder and Jones Falls water-sheds into the channel of Roland Run, a tributary of Jones Falls above Lake Roland.

In 1875 the city undertook the following extensive water-works: An impounding reservoir on the Gunpowder River at Loch Raven, with a dam 300 feet long and 30 feet high and a storage capacity of 510,000,000 gallons; a gate-house; a supply tunnel 7 miles long, leading to a receiving reservoir (Lake Montebello), with a storage capacity of 500,000,000 gallons; and a conduit a mile long to a gate-house at Clifton, with a 40-inch main to deliver water to the general mains. The new Gunpowder water-supply came into use September 26, 1881.

An additional storage-lake at Clifton Park, with a capacity of 265,000,000 gallons, was put into use in 1888.

Between 1881 and 1915, under ordinary conditions, seven-eighths of the general water-supply was derived from the Gunpowder River and one-eighth, from the old Lake Roland–Jones Falls system. However, until 1885, a small area in the southwestern part of the city was supplied by the Baltimore County Electric and Water Company.

In the 20-year period between 1862 and 1881, during which the city had enormously augmented and extended the service of the extra-urban water-supply, an ever-increasing proportion of the population must have voluntarily abandoned the internal sources derived from springs and wells. It was not until 1876 that any serious effort was made by the health authorities to have the use of well and spring waters abandoned. In that year, after a very fatal outbreak at Fell's Point of so-called typho-malarial fever (which was, however, yellow fever), Health Commissioner Stewart employed Professor William P. Tonry to make chemical analyses of the water of certain wells in this locality. All of the wells were condemned on account of the high content of chlorine and organic matter. On the basis of this report and the fact that the subsoil of Baltimore, for at least 10 of the total of 17 square miles, was contaminated from privies and cesspools, the commissioner of health concluded that all the wells and springs within the city must of necessity be polluted or subject to pollution. He therefore urged that they be closed and city water substituted.

Professor Tonry examined 84 samples of water from wells and springs in the city in 1879. He condemned 74 of these as contaminated. Many were in close proximity to privies or to cesspools. Waters from 11 wells contained a larger percentage of free ammonia than a mixture of distilled water and urine, one-tenth part of which was urine. The next year, the commissioner of health recommended the closing of all wells and springs within the city limits.

In 1885, Dr. Steuart, in his report as commissioner of health, gave a table showing the location of the wells within the city, so far as reported to the department. It was known that there were 219 abandoned wells, and that 49

dug and 13 artesian wells were still employed. He estimated that at least 100 dug wells were in use. The majority of the 49 reported were in the most crowded sections of the city. In this year, Professor Tonry condemned 12 springs as contaminated. The first investigations into the general water-supply were made during this year. Of four samples of the Gunpowder supply, from the gate-house at Loch Raven and tributary streams, three were classed as bad. One sample of this supply, taken at Lake Montebello, was suspicious. All four samples of the Lake Roland supply, taken from a city tap, were classed as good, but samples from Druid Hill Lake and Lake Roland were marked suspicious. Later in the year (July) Professor Tonry found that samples of tap-water from both supplies were suspicious.

With the annexation of 1888, a large territory, in some parts of which the most primitive sanitary conditions obtained, was taken into the city. In much of this territory the water-supply was drawn entirely from wells and springs, which, according to the report of the commissioner of health, were "without exception polluted to the foulest degree. . . . In one instance, in the village of Woodberry, there were 15 cases of typhoid fever surrounding the locality of one pump, from which these people all derived water."

The water department rushed the laying of water-mains as rapidly as possible in the more densely populated portion of this area, but for many years, especially in Hampden and Woodberry, inhabited largely by mill workers, wells persisted as the only or at least the main source of water-supply. In fact, only in very recent years, as water mains have been gradually extended, has it been practicable to close most of the wells in this annex. In the sparcely settled areas at the borders of a city there must always be some wells allowed. In Baltimore, as elsewhere, authorities have had difficulty in forcing some people to abandon wells and springs to which they were accustomed for a central water-supply, recently made available, until it could be conclusively proven that the wells were polluted. As late as 1910, 71 samples were examined within the year, 64.7 per cent of which were found to be polluted. Though it had long been generally known that both water-sheds were grossly polluted from human and animal sources, it was not until 1892 that its danger to public health was recognized and official steps were taken to remedy this condition. In consequence of complaints of possible pollution of the Lake Roland water-shed from villages and farm-houses, some inspections were made by the health department this year, and many glaring nuisances were abated. Routine sanitary inspection under a medical officer of the Lake Roland and Gunpowder water-sheds was instituted in 1896, and in this and succeeding years many sources of serious pollution were discovered and some of the worst were abated with the assistance of the State Board of Health. Many of the worst sources of pollution, which can be eliminated only by building sewerage systems with disposal plants for certain villages, still persist.

With the establishment of chemical and bacteriological laboratories in the health department in 1896 begins the first systematic study of the general water-supply. As these studies vary in scope and completeness from year to year, it is not possible to present the results satisfactorily in tabular form. While the tap-water was studied each year, the water from the tributary streams, the impounding lakes, and storage reservoirs was not examined so routinely.

For convenience in presenting the results of these examinations, the term of years between 1896 and 1919 will be divided into three periods: 1896 to 1910, 1911 to 1915, and 1916 to 1919.

During the first period, it may be said in general that the chemical and bacteriological examinations of water from Jones Falls and the Gunpowder River and certain of their larger tributaries showed a high and constantly increasing degree of pollution, as indicated by the presence of organic matter and high chlorine content, high colony counts, and the frequent presence of *B. coli* and certain other bacteria commonly present in the intestines; that this pollution was evident in the storage reservoirs to a lesser degree; and that water drawn from taps within the city, though often giving evidences of pollution, showed a decided improvement over the reservoir water. It stands out clearly, then, that the gross contamination of the water-supply at its sources was modified to a considerable degree by storage in the city's reservoirs. The reports of Dr. William Royal Stokes, city bacteriologist, show that between 1896 and 1910 there was a steady increase in pollution of the tap-water, as judged by *B. coli* content, from 4.5 per cent of the samples examined in 1896 to 57.3 per cent in 1910. Out of 854 samples examined in the 15 years, 73.3 per cent were positive for colon bacilli. Unfortunately, however, the size of the samples tested was not uniform and varied from 1 to 10 c. c. at different times. The average bacterial count per cubic centimeter of the 1,165 samples of tap-water examined from 1896 to 1910, inclusive, was 703.7. On one occasion, Dr. Stokes isolated *B. typhosus* from Towson Run.

These findings of Dr. Stokes were confirmed by Dr. William W. Ford (43). Dr. Ford's studies extended over the 5 years, 1906 to 1910, inclusive, and dealt with the Gunpowder supply exclusively. In regard to the water drawn from the laboratory tap, the colony count per cubic centimeter was usually between 500 and 600, sometimes as low as 300, and occasionally after heavy rains as high as 1,500 or even 2,000. Fermentation tubes almost constantly gave positive presumptive tests when inoculated with 1 c. c., often with 0.1 c. c., and occasionally with 0.01 c. c. samples. On further study, the fermentation was shown to be due to five main types of bacteria (*B. coli, B. proteus vulgaris, B. cloacæ, B. para-typhosus, B. fæculis alkaligenes*), of which *B. coli* was the most constant. Dr. Ford found that the number of bacteria per cubic centimeter in the Gunpowder River and some of its most important tributaries varied from 2,000 to 2,500 and that *B. coli* was present in dilutions of 0.01 or even 0.001 c. c. He traced the sources of contamination in Beaver Dam and Oregon and Western Runs, all of which were grossly polluted.

The second period, January 23, 1911, to September 15, 1915, is characterized by partial purification of the general water-supply by the addition of calcium hypochlorite constantly and alum sulphate at times. The practice was instituted upon the advice of Dr. William Royal Stokes, and carried out by the engineers of the water board. The chemicals were added to the water from suitably designed mixing tanks with mechanical control at the gateways of the impounding reservoirs at Lake Roland and Loch Raven. The parts of available chlorine per million varied at different times from 0.6 to 2.25. The remarkably good effects of this treatment are illustrated by the marked fall in the colony counts and in the percentage of *B. coli* determinations and in the decrease in the mortality and morbidity rates for typhoid fever.

The third period (after September 15, 1915) begins with the completion of the new dam and impounding reservoir at Loch Raven on the Gunpowder River and the extensive filtration plant near Lake Montebello, begun in 1911 under the advice of eminent engineers. Since this date the Lake Roland water-supply from Jones Falls has been abandoned, except for emergencies. It was used after heavy chlorinization for a few weeks in the winters of 1916 and 1917 while some necessary repairs were made to a tunnel. For at least two years after the new water-supply came into use, examinations of tap-water, made in the bacteriological laboratory of the health department, showed *B. coli* frequently in 10-c. c. samples and not infrequently in 1-c. c. and 0.1-c. c. samples. In some months over 25 per cent of the 10-c. c. samples of the tap-water were positive for *B. coli.* The findings were often at variance with the results obtained in the bacteriological laboratory of the filtration plant. During the last two years (1918 and 1919), the percentage of positive *B. coli* determinations in both laboratories was relatively low. The colony counts have been correspondingly low. Intestinal organisms other than *B. coli,* with the exception of some spore-forming organisms, have similarly become rare. If low colony counts and low percentage of *B. coli* mean pure water, this water-supply as treated at present is reasonably safe.

When the Baltimore Water Company first took its water supply from Jones Falls, this water-shed was in large degree wooded, relatively thinly settled, and not extensively cultivated. Writing in 1851, Thomas H. Buckler (11) stated that "the ordinary current of Jones Falls is much smaller now than it was when the water company was first established." This he attributed to the fact that the country, on both sides of the stream, had, in the process of time, become more open and cultivated. Owing to the substitution of cultivated fields for forests, a smaller proportion of its water was filtered through the soil and a larger proportion was surface-water from cultivated fields and therefore charged with organic matter and soil washings. In 1874 (43), he described the formerly limpid current of Jones Falls, furnished from water-sheds, as rendered impure by manure and poudrette. According to Buckler, the Gunpowder River was at that time fed by springs on a shed which was for the most part forest, or fields and meadows cultivated with burnt lime, to decompose organic matter, and not with manure and poudrette. Until 1892 no one seems to have taken into account the serious pollution of these water-sheds by human excreta from the privies in the numerous villages and isolated private houses. Many of these village privies are still directly over or on the tributary streams of both water-sheds. In fact, at the present time, many of the smaller and all of the larger tributary streams serve as sewers of direct discharge from villages, smaller settlements, and isolated houses and institutions. Human waste from many dwellings reaches the streams indirectly by pipes or by surface washings during and after rains. There are great numbers of horse and cow stables and pig sties on their banks, and many stable-yards and paddocks straddle the smaller streams. An incredible amount of valuable organic matter is annually washed into these streams. On the Gunpowder water-shed, the chief source of pollution with organic waste and intestinal bacteria is the stable rather than the privy, but the contamination from the latter is still great, in spite of what has been accomplished of late years by the initiative of private individuals, the water board, and the State Board of Health.

Unless some unforseeable revolution occurs in the methods of disposal of human waste, it is hopeless to expect that in any reasonable time the water from either of these sheds will be safe for drinking purposes without careful treatment.

On account of the enormous amount of silt from surface washings brought down from the cultivated fields by the heavy rains, the turbidity of the water is often very great, and this renders clarification and purification both difficult and expensive at times.

In recapitulation it may be said that until 1808 the water-supply was drawn exclusively from intra-urban sources, many of which had been for years seriously polluted with human and animal dejecta, with animal and vegetable waste, slaughter-house waste, and garbage, and that from 1808 this supply, growing more and more seriously polluted year by year, was very gradually but never wholly displaced by an extra-urban supply from different sources always subject to a pollution, the grade of which varied at different periods in its history.

As late as 1850 at least two-thirds of the population must have obtained its water-supply from the heavily polluted internal sources. It was not until 1862 that the external water-supply became available for over half of the citizens, and probably by this date, and certainly soon after it (due to conditions during the Civil War), this supply had become heavily polluted. These conditions were modified considerably after 1872, when Gunpowder water was to some degree mixed with that of the Jones Falls water-supply, and particularly after 1881, when at least seven-eighths of the water derived from external sources came from the Gunpowder River. The intra-urban supply was further cut down by the action of the health authorities after 1876, but the annexation of 1888 must have equalized any gain from this.

So far as the records show, the purity of the extra-urban water-supply was not suspected by the city authorities until 1892. From this time on, evidence of serious contamination was clear enough to the health authorities, who, relatively speaking, viewed the situation from a coigne of vantage; but the evidence as expressed in terms of typhoid-fever incidence and death-rates was not sufficiently strong to convince the mass of the inhabitants and the rest of the city government until 1910. Had the typhoid rates been marked higher, purification of the water-supply would have been undertaken earlier.

Why were not these rates higher? In the first place, the water-sheds were large, the cases of typhoid fever on them were probably never excessive, and the large impounding and storage reservoirs must have been very considerable factors of safety. As will be seen later, there were other factors in the spread of typhoid infection, which, taken together, were probably fully as important as water. It is of interest that, so far as can be judged by the published records of the Health Department, typhoid fever, until the last few years, is the only disease attributed to water.

FOODS.

Since the ordinances of 1797 and 1805, the city has exercised some sort of supervision and control over foods, but, so far as can be ascertained from the records, it was not until after the ordinance of 1894 that this activity rose beyond desultory attempts on the part of the market clerks, the police, and the health authorities to condemn and prevent the sale of obviously decayed meats, fish, vegetables, milk, and milk products. The purpose behind the laws of

1797 was to guard against the importation of putrescent organic material, which was considered dangerous in itself, and to prevent the shipping from the port of damaged foods which might injure the trade reputation of the city, rather than to protect the inhabitants from foods dangerous to health. Similarly, the market law of 1805 and the milk law of 1855 were probably designed to protect the purses of the poor against unscrupulous dealers, rather than the public health by preventing the sale of foods apt to cause disease. While in the reports of the health department mention is frequently found to the nuisances in and about slaughter-houses, there are no references until after 1890 to the possibility of danger to the public health from the meat of diseased animals. The State Live Stock Sanitary Board, created by act of legislature in 1888, was intended primarily to protect the live-stock interests of the State through the prevention and control of diseases destructive to animals, such as hog cholera, tuberculosis, pleuro-pneumonia of cattle, trichinosis, anthrax, glanders, hydrophobia, and the like, and in the administration of this law and its amendments the activities of this board appear to have exerted until 1916 at most only an indirect and secondary influence in the protection of the Baltimore population against such of these diseases as are common to both man and the domestic animals.

The city ordinances of 1894 and 1904 in regard to foods were directed particularly to the protection of milk, but in connection with milk, they made it mandatory for the commissioner of health to inspect meat, fish, and vegetables, to collect samples of milk and all other food products for analysis by chemical and microscopic methods, and to make regulations governing them. But with a single chemist and three inspectors appointed in 1894, anything approaching adequate supervision was impossible. Two inspectors were assigned to milk inspection and one to meat. It was not until 1912, when the laboratory and inspection forces were considerably expanded, that other activities were undertaken.

During its early history and until the development of the western packing industry, practically all the fresh and cured meats used in Baltimore were from animals raised in Maryland or in the neighboring States, and most of it was slaughtered in or near the city. At the present time this is true for a large but diminishing proportion of the beef, mutton, veal, and pork. There was no antemortem inspection of this moiety until after 1888, and during much of the time since this date any such inspection has been incomplete, to say the least. Since the inauguration of a meat-inspection system about 1900 by the United States Government under the interstate commerce act, meat sold in Baltimore from animals slaughtered in other States and in Baltimore by slaughterers engaged in interstate commerce has, of course, been submitted to careful inspection. The remaining large, but not exactly known, proportion of the meats sold in Baltimore was submitted to no post-mortem inspection until 1912. As this inspection system is conducted by a single individual, a former butcher, and as the slaughtering is carried on simultaneously at a large number of widely separated establishments, it is evident that this inspection, as judged by accepted standards, is hopelessly inadequate, both in regard to oversight and expert diagnosis. The single inspector can not begin to cover the field. According to standards generally accepted, this system is reprehensibly inadequate, and, if known, would be condemned severely by a large element of the public. However, after

an investigation of the matter in 1915, the writer concluded not to advise the city government to divert money from directions where the needs were so evidently much more marked—reform in the milk-supply, for instance—to establish the traditional meat-inspection system. The evidence that lack of such a system in Baltimore, under present conditions, does not appreciably jeopardize the public health is very convincing. The ante-mortem inspection of live animals is conducted by the State authorities, the proportion of beef and hogs slaughtered outside of the United States Government inspection, both locally and elsewhere, is relatively small and yearly decreasing in proportion, and, in this latitude, the common diseases of calves and sheep communicable to man are comparatively rare. Of greater importance, inquiry disclosed that all the cuts and organs of these animals, as used by the Baltimore population, are cooked before eating, and, further, that with the exception of a relatively small amount of "country sausage" meat, all the sausage sold is boiled by the producer before it is offered for sale. From the administrative side, due to the great number of small slaughter-houses, such a system would be enormously expensive for personnel or for a central abattoir into which all the slaughterers could be forced. More convincing than these conditions, however, was the failure to find in the health department records for 20 years previous, deaths attributed to actinomycosis, glanders, anthrax, or trichinosis, diseases which, with the exception of tuberculosis, are the surest indices of danger from unguarded butchers' meat. Under the law of 1916, the board of agriculture has broad powers to undertake meat inspection, but it has not yet entered this field.

There are no accurate figures on the proportion of the meats consumed in Baltimore that have been submitted to United States Government inspection. There never has been any systematic ante-mortem and post-mortem examination of poultry conducted by Baltimore health authorities. Much of the poultry sold is slaughtered outside of the city. Since 1910, health department inspectors have exercised a supervision over poultry sold by wholesale and retail dealers, chiefly, as with other meats, not to search out and to prevent the sale of diseased animals, but of decayed meat. Occasionally an inspector brings to the laboratory a fowl with a tuberculous liver.

In 1910, health department inspectors succeeded to the supervision formerly exercised by the market clerks, the police, and others over the sale of spoiled fish, crabs, oysters, and other shellfish. Since the State Board of Health and the oyster commission began in 1915 to supervise the oyster industry in the Chesapeake Bay and its tributaries and practically broke up the custom of "fattening" oysters at sewer outfalls and in streams known to be heavily contaminated, the danger of transmission of typhoid fever and other waterborne intestinal affections by this means has greatly diminished. The great oyster-beds have probably never been exposed to serious contamination, and the majority of the typhoid-fever deaths since 1880 and of the cases since 1900 (the date from which case reporting has been sufficiently accurate for comparison) have fallen in the hot months (July, August, September, and October), when oysters either are not eaten at all or only sparingly raw.

Until recent years, practically all vegetables and much of the fruit eaten raw have come from neighboring counties, and much of both from areas manured with night-soil from Baltimore, used either raw or as poudrette. To what degree the bacteria causing intestinal infection originally deposited in

this night-soil were killed, overgrown, and smothered by the putrefactive bacteria, or destroyed by drying in the process of manufacturing poudrette, or killed by the rays of the sun and by drying on the surface of the soil is unknown, but it is improbable that many survived to return to the city to spread disease in connection with vegetables and fruits eaten raw. It is not unlikely, however, that the dysentery amœba, a protozoan organism, part of whose life-history is characterized by the formation of cysts, may survive conditions fatal to its bacterial neighbors, and that amœbic dysentery, when this disease was an important factor in Baltimore, may have been thus spread. Perhaps a more important source of infection for the intestinal diseases was the water of polluted wells, springs, and streams with which fruits and vegetables were washed in the country; and the micro-organisms in the city night-soil capable of causing intestinal disease, probably not infrequently, when by chance the conditions of dilution and aeration were favorable to their viability, infected the sources of the farmers' water-supply. It is quite possible, too, that such vegetables as watercress, plucked at the margin of branches and creeks polluted with privy drainage and subject to overflow, have not infrequently served as vehicles for the conveyance of the intestinal diseases, particularly typhoid fever.

The milk-supply of Baltimore in the early days was derived from cows kept in stables and on lots in the city and from dairies on farms in the immediate suburbs. With the growth of the city and the development of railroads, the area from which the extra-urban supply was derived gradually expanded until it embraced the counties to the north, west, and east, up to the area beyond the Pennsylvania border. The dairies of the southern and southwestern territory of Maryland are tributary to Washington, and but little milk comes to Baltimore from the tidewater counties, whose direct connection is by water only.

The milk ordinances of 1855 and 1879, intended to prevent fraud by adulteration, accomplished nothing. No machinery and personnel for their enforcement were provided. The earliest note on the Baltimore milk-supply is that of Commissioner Benson, who recorded in 1872 that there were in the city 1,603 cows in 485 stables, with an average of 344 square feet to each stable or 104 square feet to each cow, which he regarded as very satisfactory and as evidence that Baltimore milk must be of the first quality. The first real investigation of the Baltimore milk-supply was that of Professor William B. Tonry, made at the instance of the commissioner of health in 1873, in conducting which he used the approved methods of that day to determine the reaction, the specific gravity, and the percentages of cream by volume, the total solids, water, butter fat, milk sugar, casein, and salts, and the presence of blood and pus. As a result of the examination of 13 samples of milk purchased in the city, he concluded that the best milk was that obtained from "dry-fed" cows in good city stables; next stood farm milk brought by railroad, and last was rated milk from badly stabled, sickly, slop-fed cows within the city. The best city milk contained not over 3.3 per cent butter fat; the country milk, on the other hand, contained over 4 per cent butter fat and 13½ per cent total solids. The milk of the slop-fed cows was invariably acid, and it contained a high percentage of water and a very low butter-fat content. Professor Tonry, as city chemist, reported in 1894 that of the estimated 6,658, 100 gallons sold in Baltimore in that year, 827,450 gallons came from cows within the city limits.

Milk inspection was conducted at six railroad stations, in delivery wagons which supplied households, and also in stores. Milk below the standard set by the ordinance (specific gravity, 1.029; total solids, 12 per cent; butter fat, 3 per cent) was spilled on the street. Of 288 samples of milk of which complete chemical examinations were made, 145 were watered, 69 skimmed, 23 were both watered and skimmed, 29 were colored artificially, and 5 had cream and 3 had preservatives added. Of 68 samples submitted to microscopic examination, only 4 were found clean. The picture of Baltimore milk of that date is made more complete by the following items culled from the report of Professor Tonry for the next year. He relates that a city dairyman, after giving a sponge bath to his child ill with typhoid fever, went directly to his milking and then placed five uncovered milk cans of fresh milk within 15 feet of the sick child. In the cellar of a city milk and poultry dealer, chickens were found perched on the rims of open cans filled with milk. Among the foreign matter found in milk as received at the railroad stations, blood, live frogs, dead mice, leaves, and decomposing vegetables are mentioned. Of the 1,368 cows in the city, 776 were in the old, closely built sections, most of them in ill-ventilated, filthy stables, in many of which were the family privies or water closets, and most of those animals were fed brewers' grains, garbage, slops, and decomposing tomato rinds. Over 1,000,000 gallons of milk sold this year were estimated to come from such cows. Dr. Tonry strongly advised condemning the whole lot. Nearly all the milk was sold from churns in delivery wagons on the street or at small groceries, where it was dipped from the cans as needed. Two inspectors examined 23,763 lots of milk, covering 132,646 gallons out of the estimated 7,500,000 gallons sold. An epidemic of 12 cases of typhoid fever was traced to milk.

The response to these revelations was prompt, and in 1896 was passed the first ordinance giving the health department control of milk dealers, cows, and cow stables within the city. Of especial importance were its provisions requiring prompt reporting of the occurrence of " contagious and infectious diseases " among milch cattle and in the households of dairymen and milk dealers and giving the health department powers to control the use and sale of milk from premises harboring such diseases. The improvement in the milk-supply was immediate, for the report of the chemist for this year showed a marked fall in the percentage of milk condemned for watering and skimming, and for dirt. Of 40 samples of country milk, the average fat-content was 4.13 per cent (highest 4.9 per cent and lowest 3.12 per cent) and the average total solids, 14.23 per cent (highest 16.33 per cent and lowest 12.23 per cent). The use of artificial coloring and of preservatives, and the presence of blood and pus were of comparatively rare occurrence. The interference with the watering of milk with polluted water must have exerted a marked influence upon the dissemination of the micro-organisms of acute intestinal diseases by this food. The higher standards of sanitation for cow-stables set by the ordinance of 1902, requiring non-absorbent floors, with proper provisions for drainage, and more air-space and range for cows, and the appointment of an inspector of cow-stables, combined to make it relatively unprofitable to keep cows in closely built-up sections of the city. In consequence, the worst of the city cow-stables were eliminated.

From the standpoint of adulteration, the milk-supply showed considerable improvement by 1906, for, according to the report of the chemist, of the 2,209,375 gallons, or about 14 per cent of the milk consumed, tested by the inspectors,

only 2,241 gallons were spilled, being either watered, churned, bloody, or in filthy condition. The butter-fat percentage of the 1,610 samples submitted to analysis exceeded the legal requirement by at least from 0.5 to 1 per cent.

The reports of the bacteriological laboratory for this and succeeding years indicated the needs for supervision and regulation of a more drastic type and in new directions. Bacteriological examinations of 685 samples of milk, taken in every month in 1906, showed in 403 colony counts of over 500,000 per cubic centimeter; of these, 89 showed between 10,000,000 and 50,000,000, and 10 showed over 50,000,000. *B. coli* were demonstrated in dilutions of 0.001 c. c. in 30 per cent of the samples containing under 500,000 bacteria per cubic centimeter and in 66 per cent of those containing between 500,000 and 1,000,000. The average bacterial counts per cubic centimeter of milk for the years 1906 to 1908 are given in table 5.

TABLE 5.—*Bacterial content of milk.*

Month.	Average bacteria.		
	1906.	1907.	1908.
January	1,000,000	6,200,000	1,000,000
February	2,070,000	3,600,000	2,200,000
March	1,900,000	1,100,000	5,100,000
April	930,000	2,800,000	1,100,000
May	5,000,000	3,400,000	6,000,000
June	4,000,000	4,000,000	5,000,000
July	10,000,000	5,000,000	6,000,000
August	23,000,000	5,500,000	7,400,000
September	15,000,000	14,500,000	3,200,000
October	10,000,000	7,000,000	2,100,000
November	4,100,000	4,800,000	1,500,000
December	1,800,000	3,800,000	700,000
Average	5,100,000	5,800,000	3,400,000

In 1908, Dr. Stokes demonstrated by cover-slip counts, microscopic examinations, cultures, and animal inoculations that a considerable proportion of 739 samples of milk so examined showed pus cells and streptococci virulent for rabbits. Of the 88 out of 179 guinea-pigs that survived one month after an injection of the sediment of samples of market milk, 4.5 per cent showed typical tubercles.

The investigations of the health department, together with the agitation for purer milk carried on by the United States Department of Agriculture and various State and city health departments, particularly by the Woman's Civic League and the Babies' Milk Fund, led to the comprehensive milk ordinance of 1908, under which the health department established more thorough supervision of the market milk by means of a permit system—a system of extra-urban dairy-farm and intra-urban dairy inspection, and higher standards of both quality and cleanliness. By 1913, a system of dairy-farm inspection, scoring, and instruction extended to over 1,500 dairy farms, and by cooperation with the State Board of Health, the department was able to shut off the milk from farms with cases of communicable diseases. The maximum bacterial count

for market milk was set at 500,000 per cubic centimeter. The conditions under which milk was produced on many farms was deplorable, but in a few years great improvement took place. Within the city milch cows were excluded from the closely built-up sections and milk dealers were supervised and required to meet a minimum standard of cleanliness and care in handling milk. From the reports it is clear that the conditions under which milk was handled and sold at this time contravened every canon of sanitary law and of common decency. Only a small proportion of the over 8,000,000 gallons daily sold was bottled. The provisions for washing bottles and other utensils were meager. The great bulk of the milk was sold from " churns " or metal cans with spigots, and many of these cans were rarely washed. The number of small dairies and grocery stores selling milk in small quantities and dipped from cans numbered hundreds. There were no facilities, or very meager and dirty ones, for refrigeration. The bacterial counts of milk not only at the dairies, but at the stations, remained high, and much of the milk received in the warm months registered high temperatures. Between 1912 and 1915 a large number of milk dealers adopted pasteurization and bottling of milk, and by the latter year about 60 per cent of all the milk sold was pasteurized—much of it very incompletely. As a result of a series of administrative maneuvers and educational campaigns, for which the officials concerned are heartily to be commended, and the cooperation of some of the more conscientious dealers, the milk-supply and its control had greatly improved by 1916. The goal of the health department at that time was to have all the milk produced from healthy cows, handled under sanitary conditions, by healthy workers, from farm to the consumer, properly pasteurized within the city, and delivered in sterile containers. Owing to the very general terms of important parts of the ordinance of 1908, much of the administrative effort of the officials was of necessity executed under regulations issued by the commissioner of health, some of the most salutory items of which were attacked as unreasonable by recalcitrant dealers and in consequence were held up indefinitely in court. This knot was cut in 1917 by the passage of an ordinance, which, by covering specifically questions immediately in view, was elastic enough to grant power for the use of such alternate procedures as in the future might seem wise. Under these additional powers, the health officials have been able to control producers indirectly and dealers within the city directly, so as not only to improve greatly the sanitary conditions under which milk is produced and sold, but to establish grading of milk. The result is that many poorly equipped plants and numerous dealers ignorant of milk handling have been eliminated. Table 6 shows the fall in the bacterial count of pasteurized milk since the law went into effect in November 1917.

The improvement is greater than appears, however, for in the years immediately preceding, 40 per cent or over of the milk used was raw, and much of that was served by the most illy equipped dealers. Besides the numerous epidemics of typhoid fever traced to milk, there was a severe epidemic of septic sore throat spread by the milk of one dairy in 1912. It may now be said that the public milk-supply of Baltimore has been safe and generally within the legal standard since 1919.

In the Baltimore market, milk products are relatively unimportant, with the exception of butter, cheese, and ice cream; concerning the two former, because

of the widely diverse sources of origin and great quantity and technical difficulties in the way, no attempt at supervision for pathogenic micro-organisms has been attempted. The investigations of the health department have shown that, until the last few years, much, if not most, of the so-called ice-cream was made of impure, dirty milk in cellars and stores, under conditions of filth almost unbelievable. Under the inspection system developed in 1912, both the sanitary conditions under which this article is manufactured and the standard of purity of its ingredients have been greatly improved. Since 1917, the use of only pasteurized milk and cream in ice-cream has been permitted. The one saving feature, from the sanitary viewpoint, was the fact that in making the ordinary ice-cream, the mixture was usually cooked.

Since 1900, the inspection of bakeries and confectioneries has been carried on under the health department, and since 1912, the making and sale of bread and candies has been closely supervised.

TABLE 6.—*Levy average of numbers of bacteria per cubic centimeter in samples of pasteurized milk (about 300 monthly) collected from wagons on the street.*

Month.	Levy average of numbers of bacteria per cubic centimeter.		
	1918.	1919.	1920.
January	282,000	56,000	13,000
February	475,000	41,000	8,300
March	450,000	54,000	15,000
April	650,000	52,000	11,000
May	1,500,000	96,000	22,000
June	1,200,000	130,000	21,000
July	1,500,000	120,000	34,000
August	1,700,000	110,000	42,000
September	840,000	120,000	33,000
October	350,000	74,000	22,000
November	115,000	14,000	12,000
December	71,000	27,000	12,000

Besides those foods above mentioned, analyses have been made for several years in the chemical laboratory of canned vegetables, meats, and other foods for impurities and the illegal use of preservatives, but in 1916 work of this character was discontinued as a routine practice, to avoid duplicating similar work conducted by the State Board of Health.

II. PREVENTION AND ABATEMENT OF NUISANCES ON PRIVATE PROPERTY.

Since March 20, 1801, when the commissioners of health were granted power to enter all lots, grounds, and buildings on which nuisances of any description might exist, down to the present day, the prevention and abatement of nuisances on private property have been among the chief activities of the department, and in the exercise of no other function have the health officials been brought into such intimate relations with the people. For many years this function and the activities in connection with small-pox (vaccination and isolation) formed almost the sole basis of such contact. In general, the necessity of the public oversight of nuisances on private property has varied directly with the condition

of public sanitation. The bulk of the nuisances has concerned water and organic waste. Only since 1886 has cognizance been taken of nuisances caused by the conditions and structure of buildings as buildings. Having accepted early and retained late the doctrine that certain diseases, conveniently called nuisance diseases, are caused by the putrefaction of dead organic material and having observed that moisture favors this process, in the opinion of both the people and the authorities, it became a principal and constant duty of the Health Department to the full bent of its power, means, and personnel, to keep these two things apart. To this end the department has always had, in addition to its own resources, the right by law to call upon the police department, the legal forces, and the magistracy of the city. The early ordinances concerning coffee and hides; bark and the like on the wharves, docks, and in the basin; sawdust and lumber in woodyards; offal of slaughter-houses, carrion, and garbage on public and private domains; and water in cellars and yards, were all directed at the prevention and control of malarial, yellow, and typhus fevers, dysentery, and cholera. Later, diphtheria, typhoid fever, and other acute intestinal diseases were included among the diseases to be similarly fought. Throughout the whole history of the health department, a large portion of its activities has centered around nuisances of these types, and in the annual reports of the department much space is occupied with their discussion.

STANDING WATER.

In regard to lessening the amount of standing water on private property, much was accomplished. By construction, filling, and drainage, results of a more or less permanent character could be obtained, but, because of the topography of the land and the rapid growth of the city, progress was slow and design was always ahead of accomplishment. The securing of dry cellars was a matter of considerable difficulty in many parts of the town, due to the abundance of springs and to the fact that so much of the city was built upon low-lying "made ground." In many parts of the city at the present time it is necessary to drain cellars with the help of various kinds of automatic pumps or cellar drainers worked by water power. A very considerable proportion of the nuisances reported to the health department for correction, at the present day, is due to water in cellars, defective draining of yards and alleys, broken or otherwise defective rain-spouts, and leaks in roofs, all of which are correctable on orders issued by the health department, calling for new construction or for repair of the old.

Shortly after the discovery of the relation of mosquitoes to the spread of malaria and yellow fever and at a time when these pests were common in many sections of the city, the question of the appropriation of money for the control of this nuisance was agitated in the city council. It was not until 1907 that provision was made for the annual expenditure of $10,000 for this purpose under the commissioner of health. In 1915, upon the advice of Surgeon-General W. C. Gorgas, of the United States Army, the ordinance of that year was passed, and an anti-mosquito campaign along lines familiar to sanitarians was inaugurated under the administration of the department of street cleaning. This activity has been continued with marked success, but it is only fair to point out that it was not undertaken until long after malaria had practically disappeared from the city.

ORGANIC MATERIAL.

In the early days of the city's history, coffee and hides were the chief imports of foreign origin likely to undergo putrefaction. Since these came from hot climates in wooden ships apt to leak and to have foul bilges, conditions favorable to their decay often existed, and law and custom demanded their active supervision and their prompt removal from the city to special locations for airing and drying. Great quantities of fish, shellfish, vegetable produce, and firewood were unloaded on the wharves of the basin from small vessels plying in the Chesapeake, and the considerable offal from these sources created nuisances to be supervised by the health department.

The sawdust and other timber waste of the extensive ship-building and cooperage plants, all situated in the low-lying parts of the city, near or on the marshes bordering Harford Run, Jones Falls, or the basin, furnished putrescible material in quantities calling for control by burning the waste material and by liming the grounds. So far did fear of the dangers from the decay of wood go that it was required that all lumber and firewood be so stacked that air would have access to each piece.

The health department, with the assistance of the police, has throughout the history of the city undertaken to enforce ordinances and regulations concerning the keeping of yards, areas, private alleys, and courts clear of dirt, rubbish, and garbage, but it was not until 1916 that the use of covered metal garbage-cans was enforced throughout the city. The prompt removal from private domains of carrion, i. e., dead animals other than those slaughtered for food, governed by stringent ordinances since 1797, was exacted of the owner until in recent years.

Though, since 1797, the running at large in the streets of geese, swine, and goats has been forbidden by law, these and horses, milch cattle, chickens, and pigeons have been allowed on private property and have been a constant source of nuisances.

There was no ordinance controlling stables for cows until 1896, and it was only in 1902 that the law was sufficiently comprehensive to lessen nuisances from this source to any considerable degree. The numerous horse-stables, usually situated on alleys, courts, and small lots, and without manure-pits adequate in either size or structure, were fruitful sources of nuisances until 1913, when suitable regulations were issued by the commissioner of health and have since been enforced by the police and the health officials. These regulations, requiring cleanliness of stables, the placing of manure in well-covered, water-tight pits, treatment with borax when necessary, and the emptying of the pits and the removal of their contents every seven days between April and November, were designed primarily to control the fly nuisance. The enforcement of these regulations, together with reforms in the care and removal of garbage and in the cleaning and draining of streets and alleys, has resulted in a very marked decrease in the number of flies, which in earlier days swarmed in certain districts in incredible numbers.

The greatest source of nuisance upon private property during the history of the health department has been household drainage containing organic matter—that is, household waste-water and human waste—which was never well controlled until the completion of the dual sewage system, by the so-called sani-

tary section of which disposal of these materials is now satisfactory. Until this time, the household wash-water, consisting of kitchen slops and kitchen, laundry, bath, and basin wash-water, passed by open brick drains or by closed drain pipes, either of wood, iron, lead, or terra cotta, to the street gutters. In many cases, where these drains led from the front of the house, the connections were direct, or at least over a slight gutter-like depression in the front pavement, leading from the house pipe to the gutter. From the majority of the houses the house drains discharged into the alley in the rear, or alongside, and the waste-water followed a long and tortuous course over the rough alleys to the street gutters. This system, at best, was a fruitful source of nuisance because of the stoppage of drains and pipes and the accumulation of material in gutters blocked with paper and other rubbish; at its worst, due to defectively paved or unpaved and poorly graded gutters and alleys, larger and smaller pools of putrescible fluid collected. Always unsightly and often disgusting, this material caused nuisances of two types: in cold weather it froze, resulting in broken pipes and drains and sheets of ice in yards, alleys, gutters, and street beds, and in warm weather it gave rise to nauseous odors, drew and fed flies, and served as breeding-places for mosquitoes.

Of all the functions and activities of the Baltimore Health Department, none has played continuously a more important part than that of controlling nuisances connected with human wastes. Owing to the absence of a general system of sewerage, this material was, of necessity, until within the last few years, deposited on the householder's lot, either on the surface, in the crude privy, or into the ground in the privy-well. The development of the laws relating to this subject has been traced in the section on sewerage.

It is certain that the privy-well, privy-vault, or cesspool was in existence and widely used by 1797, but the date is not known when it began to replace the surface privy. It is probable that until the population of Baltimore grew rapidly during the Revolutionary War and houses were constructed in closely built-up blocks instead of being separate, as is the custom of villages, the surface privy was common. Under those changed conditions people would have sought a less disagreeable method for the disposal of human excrement, and the adoption of the cesspool, where the nature of the ground would permit it, was natural. The great trouble with the cesspool system, even when the pools or vaults were water-tight, was that, as with the privy, the night-soil had to be removed. Constant care and oversight were necessary to have them emptied before they became full. With the introduction of the water-closet the filling and overflowing of the cesspool were more rapid and frequent. Situated either in the yards or under the cellars of buildings used for dwellings or business, the overflowing cesspool was the most serious of all private nuisances.

Since 1801 the health authorities have had the right to supervise privies and cesspools, but regular inspections were not required until 1872, when annual inspection was required between June 1 and 10. Those which were full or likely to be full before October 1 were declared in a state of nuisance and ordered to be cleaned. In 1886, the health commissioner was given the power to have privies cleaned and other nuisances abated at the expense of the owners, agents, or occupiers, when they had neglected to do so, and the cleaning of privies was prohibited between June and October, except in case of necessity.

It was never the duty of the health department to clean privies and cesspools or to remove night-soil, though it always supervised this work, which was carried out by licensed night-soil men. Mr. C. E. Latrobe, C. E., estimated in 1881 that it cost the citizens $96,000 annually to have the contents of their cesspools removed. Throughout the history of the health department the reports of the commissioners call attention to the great number of nuisances due to overflowing privies and cesspools and to the difficulties in the disposal of night-soil.

The final disposition of the night-soil was always a vexed question. Much of it was dumped with garbage on dumps, within and without the city limits, and it is probable that from an early date much of it was sold directly to nearby farmers for use in the raw state or as poudrette (dried night-soil mixed with charcoal and gypsum). The commissioner of health in 1864 strongly recommended the use of raw night-soil for manure, as in Europe and in China. It is mentioned in the report for 1870, as a great reform, that three dumps for night-soil and street sweepings had been established in open places in the suburbs, each under the charge of a keeper who took account of the number of loads received and sold. In 1880 the method was changed, and night-soil was hauled by contractors to Winans's Wharf, near the extreme southerly point of the city, or to Folley's Wharf, at the southeasterly limit, loaded on barges, and towed to some one of 35 localities on Bear Creek, on Middle River, or on North Point Creek, where the contents were transferred by pumps to pits or tanks, whence it was purchased and removed in tight wagons by the farmers of the several neighborhoods and directly applied to their fields. The heavier portion, which collected at the bottom of the tanks, was applied to the surface of fields owned by the contractor, where it was worked up into a compost and sold as a fertilizer. There was evidence that a great deal of this material found its way into Bear Creek. At this time there were 150 different firms or individuals licensed as night-soil men. This method of disposal was continued until 1917, when, because of the small amount of night-soil, the business ceased to be remunerative. Since this date the relatively small amount of this material to be disposed of has been dumped into the sanitary sewers at convenient points.

The first closets were directly over the cesspools, either in the yard, or on back porches, or in a room connected with the latter. In the larger houses, closets of this type were on the porches of several floors. With the development of the "water" or "flush" closet, the indoor closet, usually in the bathroom, became common. The earliest type of "water" closet in use in Baltimore was the "pan," consisting of a bucket or "pan," which, when a lever was pulled, tipped over and emptied its contents into the drain pipe leading to the cesspool or sewer. It was inadequately flushed by about a gallon of water. This model was in common use in 1885 and was to be found in old houses as late as 1915. The long and the short "hopper-closets," improvements over the pan-closet, were next very generally used, especially in yards. The modern flushing closet came into use very slowly.

A division of plumbing, with an inspector of plumbing, was established in 1883 at the earnest request of the commissioner of health, who, after investigations had been conducted for several years by his sanitary inspectors, reported that in every household in which there had been a death from typhoid and scarlet fevers and diphtheria there was "defective plumbing" or overflowing cess-

pools. At this time the closet connections with the cesspools and private sewers were either imperfectly trapped or untrapped, and their odors often permeated houses or whole neighborhoods. It was not unnatural that a people bred to the belief that such diseases as diphtheria and typhoid and typhus fevers are caused by poisons in the air resulting from putrefaction should embrace and cling to the sewer-gas theory of their causation.

Judging from the reports of the health department, the sewer-gas theory, which was responsible for the establishment of plumbing inspection, dominated the department from 1875 until 1895. It doubtless served a good purpose in drawing attention to the dangers and inconveniences of the cesspool and to the necessity for tight plumbing. It had the deplorable consequence of elevating the scientifically uneducated plumber to a position of authority in hygiene. This ascendency of plumbing is not to be blamed upon the plumber, who did not invent the doctrine, which, with the mechanical inventions connected with his trade, stimulated the demand for his useful work. The "defective plumbing," to which so much disease was thought to be traced, was defective, as is shown by the reports of Mr. Lee, the first plumbing inspector, not only in being untrapped or improperly trapped and vented, but in structure and in location as well. The sewer-gas theory of disease, imported from England and adopted without reservations in the Baltimore health department, though like so many theories in medicine quite without basis in fact, was made to serve the very useful purpose of greatly improving plumbing. Under the regulations of the commissioner of health in 1898, based upon the plumbing ordinance of 1883 and the system of inspection carried out, the public was gradually forced to install more and better plumbing and was protected against fraud in its installation. This system was of particular help to tenants, who, on appeal to the health department, could have long-standing nuisances abated. The additional provisions of the building code of 1908 and the power given to the department by the sewerage act to force house connections with the sanitary sewers; the manner in which these have been administered by the department, and finally, the development of the modern toilet, have resulted in a complete revolution of the privy and closet nuisances. The supervision of the house connections and construction of the plumbing systems of over 90,000 buildings between 1912 and 1918 was a considerable administrative feat. There remain, however, some 25,000 houses still dependent upon the cesspool, and in connection with a considerable number of old houses in the older, crowded parts of the city, there are yard toilets with "hopper" closets, many of which are imperfectly flushed and are frequently out of order.

Some idea of the activities of the health department in the control of nuisances on private property may be obtained from the following summary of the report for 1880: The total number of nuisances examined by sanitary inspectors was 4,292. Some of the principal items were: Alleys graded, paved, or repaired, 320; premises cleaned and disinfected, 246; cellars cleaned and connected with sewers, 803; privies reconstructed and repaired, 862; vacant lots drained or filled up, 159; drain pipes constructed and repaired, 158; yards cleaned, drained, paved, and repaired, 228; slaughter-houses and packing houses inspected, 33. In addition, notices and orders to remedy unsanitary conditions were issued as follows: Notices issued to clean privies, 17,445; to repair yards, 530; to clean and bail out cellars, 560; to grade and pave alleys, 4,863; to drain

and fill up lots, 287; to clean and repair water-closets, 520; to clean, drain, and repair premises, 380; to clean and properly construct manure pits, 140; to clean grass and weeds from lots and gutters, 560; a total of 25,285. There were 18,887 permits issued to open sinks.

In contrast to the above, 73 fatal cases of infectious diseases were inquired into.

In 1890 it was reported that the sanitary inspectors had examined and had abated 34,138 nuisances. There were issued 14,345 notices and 43,989 permits to clean privies, and 10,409,800 gallons of night-soil were removed from the city by contractors.

The reports of succeeding years, until 1918, when house connections with the sewerage system were completed and half the alleys were properly paved, show corresponding increase in nuisance supervision and control of these types.

MANUFACTORIES.

It will be noted that section 6 of Ordinance 15 of 1797 and the provisions regarding manufactories inimical to public health made in succeeding ordinances were directed at the prevention of offensive odors and the accumulation of organic material on the property of manufacturers or its discharge upon streets and alleys or upon the properties of others, and they in no way prescribe safeguards for workers in connection either with the structure, lighting, and ventilation of shops and factories, or with personal contact with micro-organisms, chemical poisons, or irritating particles. Those omissions are doubtless due in large part to the fact that industries of these types have not been numerous until recently in Baltimore. All the child-labor and factory laws are general State laws passed since 1884 and are in large degree executed by State officials.

The ordinance of 1871, which provided that no slaughter or hide houses should be erected within the city, has not in any marked degree decreased the number of such places within the city; for, with the annexation of 1888, a territory containing nearly all the slaughter-houses near the old city came within the corporation. Most of these were small private slaughter-houses for sheep, calves, and cattle, situated in the rear of the homes of their owners, who are for the most part cleanly and thrifty market butchers, selling meats of their own killing. The existence of most of these small slaughter-houses is unknown to the casual passer-by, and they are but rarely the subject of complaint on the part of neighbors. Frequent subject of complaint, however, are the premises of poultry slaughterers in certain sections of the city. There are a few large slaughter-houses for hogs, established many years ago, in the closely built-up sections of the city, convenient to the railroad tracks, but these are rarely, if ever, at the present day at least, the source of nuisance. At the northwest border of the city, without the city limits before 1919, are the slaughter-houses of the large packers and the stockyards and Union Abattoir.

HABITATIONS.

The laws applying to habitations passed between 1871 and 1908, in so far as they relate to structure outside of plumbing, are under the administration of the inspector of buildings, and in so far as they concern cleanliness and manner of keep, are enforced by the health officials.

With the exception of those provisions that deal with safety where dependent upon strength and mode of structure, the main object of the ordinances of 1884 and 1908 was to set a minimum standard of light and air ventilation compatible with health, to secure against dampness, and to provide adequate water and toilet facilities.

The ordinance of 1884 was passed opportunely, for about that date many old houses in the lower parts of the city, being vacated by their former owners or tenants, were being transformed into boarding-houses or into two and three family dwellings. In the larger of these there was the temptation to divide the very large rooms into two or more rooms, one or two of which would be entirely devoid of daylight. This law also put an end to building houses with a windowless central room on each floor.

In 1900 there was established in the health department a division of tenement-house inspection, to which were referred not only the general oversight and supervision of tenements, and of lodging and boarding houses, but all questions relating to nuisances therein. To this end, dwellings of these sorts were placed under a system of repeated systematic inspection designed, on the one hand, to force the landlords to make necessary repairs and renewals—whitewashing, painting, and the like—and, on the other hand, to require the tenants to observe the rules of cleanliness.

The ordinance of 1908 was intended particularly to control the modern tenement and apartment house.

III. MEASURES OF RESTRICTION, INOCULATION, AND DISINFECTION DIRECTED AGAINST THE CONTAGIOUS DISEASES.

Under this heading it is proposed to give a general account of the attitude of the health officials toward the control of the spread of febrile diseases, especially those regarded as contagious, by administrative measures other than the control of nuisances and the order in which their control was attempted. Consideration of the methods used in seeking to control particular diseases and groups of diseases is reserved for later chapters. It is to be borne in mind that the official attitude in regard to a given disease varied at different times. For this there were many reasons, one of the most important of which being the changes in the knowledge or belief in regard to its causation and mode of spread. Another reason was the idea entertained of its relative importance at any particular time. A third reason was lack of organization and of means at all times to pursue ideas to their ultimate conclusions and thus to do thorough work. From the health reports and from contemporary literature, both medical and lay, and from administrative experience, the indelible impression is gotten that, throughout its history, the Baltimore health department has followed a vacillating course, dependent in great degree, at times certainly, on lack of means and public support and often on absence of intelligent direction. For these reasons its course has been one of expectant opportunism, and it has rarely met facts squarely face to face.

In certain respects, its attitude has been consistent; for instance, in holding that malaria and yellow fever are not contagious, and are due to conditions associated with standing water and decaying vegetable material; that whooping-cough, measles, and small-pox are caused each by a specific morbific agent spread from the sick to the well by personal contact or by contact with materials inti-

mately associated with the sick; and that small-pox may be prevented by vaccination. Yet the efforts put forth were never sufficiently adequate to test these doctrines. Certain diseases, such as diphtheria and typhus fever, were tossed from one category to another. Long years elapsed after it had been shown that cholera and typhoid fever are commonly spread by water and after it had been proven that these diseases and diphtheria and scarlet fever are often carried by milk, before such knowledge was reflected in the conceptions and activities of the health department.

That officials may exercise properly their function of attempting to control the occurrence or spread of diseases, it is necessary in the first place that they be informed promptly of the name and address of each case. For the exertion of effective control, it has long been held that they must have ample power to isolate the sick and those in contact with them, to disinfect and destroy clothes, bedding, furniture, and even houses. In 1801, physicians were "invited" by ordinance to report "contagious diseases," and the commissioners of health were empowered to remove persons ill with such diseases to a hospital or other place and to cut off communication with the "affected house." When such a disease threatened to become general, they were authorized to advise the inhabitants to remove to quarters provided for the purpose. From contemporary medical literature, it is certain that small-pox, typhus fever, and yellow fever, when in epidemic form, were reported under the terms of this invitation, and that many individuals ill with these diseases were hospitalized; that on more than one occasion, on account of yellow fever, the inhabitants of Fell's Point and other infected districts followed the official advice to flee, and that many were supported in camps at the city's expense.

The ordinance of February 10, 1820, in which the health laws were revised in conformity with the advice of the local medical society, contained two significant new features—one requiring physicians to report cases of malignant, pestilential, or contagious diseases, and the other requiring keepers of taverns and lodging houses to report cases of illness occurring between March and November among seafarers or other sojourners in their houses. This ordinance was reenacted 19 days later, eliminating the section which required the reporting by physicians. This step was probably taken at the behest of certain prominent physicians at Fell's Point who had become disgruntled the previous year because, while they, themselves, had loyally reported cases of yellow fever, physicians in other parts of the city, so they claimed, had neglected or refused to do so. The health authorities had to remain content with voluntary reporting. The provision requiring the reporting of cases of illness in taverns and lodging, and boarding houses has been retained in one form or another in succeeding ordinances.

The law of 1821, which empowered the commissioners of health to fence off and surround by sentinels any district in which yellow fever was "confirmed and beyond control," was designed rather to keep people out of such districts than to prevent the exit of those living therein, because it had been decided in 1819 for all time in Baltimore that this disease is not contagious. It had been observed, however, that it was dangerous to allow persons to expose themselves to the air of the districts in which yellow fever cases have originated. It was the locality and not the sick that was considered dangerous. This provision was reenacted in the various revised ordinances and appears in the code of 1869.

When cholera first appeared in 1832, it was officially declared to be non-contagious, and the dispensaries and emergency hospitals that were established were designed avowedly for the early treatment of the poor and for the better care of the dangerously ill rather than for isolation. Similarly in 1866, cases of cholera were reported, and though only one case (the whole number is not recorded) was traced to contact with a previous case, care was taken to remove and to destroy everything used by those affected with the disease and to disinfect and to bury the discharges of the sick, and many were removed to a hospital.

There is evidence that in the early years, isolation, hospitalization, and disinfection were practiced in the control of typhus fever, and after 1840, many cases were sent from the city to the pest-house at the Marine Hospital. In 1866, the commissioner of health reported that a small epidemic of typhus fever was controlled by sending the sick to the hospital. However, in 1851, T. H. Buckler sharply criticized the authorities for sending typhus fever patients to the general wards of the almshouse infirmary.

Small-pox, the most dreaded of all the epidemic diseases in Baltimore, as the reports of the health department show, was always reported (though the number of cases is unfortunately not recorded for all the years) and was consistently fought by vaccination, by hospitalization of the sick and isolation of the exposed, and by fumigation or destruction of personal effects. In 1824, four emergency vaccinators were appointed, and since 1826, the position of vaccine physician has been permanent. Vaccination first instituted for the poor was enforced with vigor in times of epidemics. The section of the ordinance of 1834, in which physicians were requested to report cases of small-pox within 24 hours, under threat of having the names of those who neglected or refused to do so published, passed at the beginning of an epidemic, was modified in the revised health ordinance of 1838 with omission of the threat. Small-pox was put on a level with other diseases in the code of 1869, in which even the request to report was eliminated.

There is no allusion in the health department reports to efforts at the control of diphtheria, scarlet fever, measles, whooping-cough, and typhoid fever by isolation, hospitalization, or otherwise, until late in the nineteenth century. The prevalence of scarlet fever and measles, both in fatal form, is often mentioned, and as early as 1838 the consulting physician gave it as his opinion that "scarlet fever and measles occur under no fixed laws and both seem inclined to abide with us." Diphtheria, scarlet fever, and typhoid fever, all widely prevalent in 1875 and for a number of years thereafter, were attributed to sewer gas. That diphtheria and typhoid should be considered foul-air or nuisance diseases at this time is not strange, but that scarlet fever, a typical exanthematous disease, considered for hundreds of years a specific contactive disease, should have been included in this group, is surprising.

None of the diseases just mentioned were included, so far as the reports of the health department show, among the reportable diseases until 1882, when by ordinance diphtheria and scarlet fever, together with small-pox, varioloid, cholera, and yellow fever were specifically named as diseases to be reported within 24 hours by physicians, and keepers of hotels and boarding and lodging houses, by agents and owners of tenement houses and private houses, and by the managers of institutions. The list was amplified by ordinance to include

whooping-cough, mumps, and membranous croup in 1890, but it was not until 1895 that typhoid fever was added. Typhus fever has never been made reportable in Baltimore by ordinance. Though between 1870 and 1890 the commissioners of health recorded the sending of inspectors to visit the houses of individuals dead of diphtheria, or scarlet or typhoid fever, certain it is that so far as management of persons is concerned, nothing was attempted during these years for the control of febrile diseases except small-pox. During this period, scarlet fever, measles, diphtheria, whooping-cough, and typhoid fever were not only very prevalent but very fatal, as attested by comments of the commissioners. The department seems to have exhausted its energies over small-pox, typhus fever, and nuisances. It was not until 1890 that communicable diseases were reported in considerable numbers. In that year, 2,593 cases were mentioned as visited by sanitary inspectors.

The commissioner of health at this time, Dr. George F. Rohé, the first who had a first-hand acquaintance with pathological anatomy and parasitology, revived the case-reporting and advised disinfection and fumigation of rooms and houses after death or recovery from contactive diseases and recommended systematic hospitalization of cases of diphtheria and scarlet fever. Dr. Rohé, finding that a large proportion of the children in the public schools, though possessing physicians' certificates, had never been successfully vaccinated, excluded the unvaccinated and thus laid the foundation for systematic requirement of vaccination of all school children as a condition precedent to admission into school in Baltimore.

In 1892, the era of active and concerted attempt to restrict contactive diseases other than small-pox and typhus fever may be said to have begun. The number of vaccine physicians, who acted also as health wardens and to whom fell the duty of establishing such isolation and quarantine in households as was attempted, was doubled, one being allocated to each of the city wards, and the number of sanitary inspectors was increased to 11. The sewer-gas doctrine was dropped, and though attention to nuisances absorbed to a very large degree the activities of the department, there are indications of a more critical consideration of the natural history of the febrile diseases, resulting in a recognition that certain of them may be spread in a variety of ways. As has been shown in another chapter, this change was to a very great degree due to new influences that had arisen in the medical profession of the city. Reports of 7,475 cases of "infectious diseases" were received this year, many children from "infected houses" were detected in schools, disinfection and fumigation of houses are said to have been carefully done, and 12,690 articles of clothing and bedding were disinfected.

By 1894, the commissioner of health had demanded a bacteriological laboratory for the diphtheria-culture test, provision to obtain diphtheria antitoxin for free distribution, and the establishment of a special hospital for infectious diseases. He was granted a chemist and three inspectors for the control of food, and efforts to improve and protect the milk-supply were pushed.

The report of the commissioner of health for 1895 is remarkable in that it gives the number of cases of each communicable disease reported, contains an intelligent discussion of the causation of typhoid fever, with an account of a milk outbreak of this disease, and recognizes that the causative agents of certain diseases may be spread in several ways.

The year 1896 was another turning-point in the attitude of the department toward communicable diseases. It is not going too far to state that up until this time everything, and indeed much more that the department had undertaken and accomplished for the control of disease (vaccination against small-pox excepted), could have been done just as effectively under the influence of the ideas and knowledge of a hundred years before. While its previous efforts doubtless had some considerable influence in restricting some diseases, careful examination of all the recorded facts fails to elicit convincing evidence that, so far as those diseases believed to be entirely or even mainly spread by contact are concerned, the Baltimore health department had ever applied Mead's recommendations systematically and thoroughly to the control of even one of them, or that any one of these diseases, even small-pox, to which it was particularly attempted to apply these principles, and even with the assistance of vaccination, was controlled when in epidemic form in any appreciable degree. As is clearly shown from the statements of the commissioner in this year, no consistent attempt had been previously made to carry out isolation, hospitalization, and disinfection in connection with the control of these diseases under legal authority possessed, since 1801.

From 1896 begins in the health department a more serious effort to apply consistently old knowledge and theories, with modifications and amplifications, under the stimulus of the rapidly accumulating knowledge of modern chemistry, pathology, and micro-parasitology. The commissioner of health pointed out that efforts to restrict infectious diseases in past years had not had the desired effect, and attributed this failure to neglect by physicians to report cases; lack of sufficient funds and appliances; the superficial and inadequate character of the methods of disinfection employed; and the absence of a properly trained corps of disinfectors, of a steam disinfecting plant, of sufficient hospital facilities, and of adequate supervision of the infected. Patients were discharged from isolation and quarantine under no fixed rules and on the certificate of the attending physician that in his opinion danger of transmitting the disease had passed. In addition to remedies for these delinquencies, he suggested a system of school inspection and the inauguration of measures to prevent pulmonary tuberculosis. This year was further distinguished by the establishment of laboratories of chemistry and bacteriology, at the heads of which were well-trained men. In the latter, the advantage of laboratory diagnostic methods for diphtheria, typhoid fever, malaria, and tuberculosis were at once offered, and investigations of water and milk were undertaken.

There were developed in the department, during the next few years, the restrictive procedures including isolation and household quarantine, placarding, supervision by health wardens, discharge certificates, culture tests, formaldehyde disinfection of rooms, steam sterilization of clothes and bedding, the development of methods to prevent the spread of diseases through milk and other foods, and the like, which in the main accord with the standard practice in English and American municipalities. It is remarkable that the placarding of houses harboring cases of communicable diseases, with the exception of small-pox, does not seem to have been practised by the Baltimore health department, until it was introduced in 1898 for diphtheria by Commissioner C. Hampson Jones.

Sydenham Hospital, accommodating 40 cases of diphtheria and scarlet fever, was opened in 1909, and its capacity was increased to 60 beds in 1915.

In 1904, a new structure was completed at the quarantine station to receive cases of small-pox and typhus fever from the city.

Since 1898, creditable studies concerning the occurrence and distribution of diphtheria, scarlet fever, small-pox, typhoid fever, tuberculosis, and pneumonia have been made by Dr. C. Hampson Jones and Dr. William Royal Stokes.

A system of medical inspection of school children was inaugurated in 1905, and in 1910 a division of tuberculosis, with nurses and dispensaries, was established.

Since the health department by 1898 was committed to the theory that the spread of diseases regarded as distinctively communicated by contact from one person to another is controllable by isolation of the sick and disinfection or destruction of their contactive environment and deliberately set out to base administrative practice upon this theory, it becomes necessary to examine both the possibilities and the results as measured in actual control of these diseases. The century-old plan comprehends early and complete isolation of the affected and his contacts and disinfection by physical and chemical means of his contactive environment.

It has been pointed out that before 1898, except in connection with small-pox and, on occasion, typhus fever, the health department pursued a policy of *laissez-faire,* most measures to this end being undertaken on the initiative of the family physician or the family of the affected. With the exception of small-pox and typhus fever (when not prevalent in excessive degree), adequate facilities for hospitalization of more than the merest fraction of the total number of cases of scarlet fever, diphtheria, whooping-cough, measles, epidemic meningitis, poliomyelitis, typhoid fever, cholera, and pulmonary tuberculosis have never been available to the health department. For these diseases, therefore, such isolation as it has been possible to attempt has been confined for practicable purposes to the households or institutions in which the patients were domiciled. Since an overwhelming majority of families live in dwellings of not over six rooms, with but one bath and toilet room, and the mother does the cooking and household work, with only the help that older children or other members of the family are able to give, complete isolation of the sick is manifestly impossible in most homes. Since nearly all of the institutions, including orphan asylums, hospitals, and the like, until the last three or four years, have lacked adequate rooms and other facilities for isolating those sick of the communicable diseases, those diseases which readily spread by contact when once present are apt to run their courses but lightly influenced by restrictive measures. Measles, whooping-cough, diphtheria, scarlet fever, mumps, and chicken-pox, the more common diseases of this category and the ones which are particularly apt to be transferred to others during the prodromal or incubative stages, have, therefore, in the great bulk of the homes and in most institutions defied the attempts of physicians and the health department to prevent their spreading to all or to most of the susceptibles within their walls. As is well known, in families with the largest houses and the most favorable conditions of structure and service, these diseases, when introduced, commonly spread to the susceptibles at will. The same is equally true of epidemic meningitis and of poliomyelitis. It is clear, therefore, that, in the nature of things, the most that can be hoped for is to restrict these particular diseases to the members of the household. For some years the health department has permitted and even encouraged the sending of

children exposed in their homes to scarlet fever, measles, and mumps to the homes of relatives or friends without children, under proper restriction. As a matter of fact, in the ordinary household or institution with children and young adults, it is with few exceptions the rule in Baltimore, as elsewhere, for measles, whooping-cough, mumps, and chicken-pox, when introduced, to attack all the susceptibles either at once or in rotation, and, in the case of diphtheria, for a large percentage of those exposed to develop the carrier state at least. With scarlet fever, under similar circumstances, it is not uncommon for several or for all of those theoretically susceptible, i. e., under 20 years of age and not protected by a previous attack, to escape, even when contact with the sick has been close. The same holds true usually for poliomyelitis and for epidemic meningitis in ordinary years, though, in regard to the latter disease, a considerable proportion of the inmates are proven by cultures to harbor the causal agent. In regard to small-pox, the danger of spread within the family or institutional population is lessened in proportion to the number of inmates who have previously passed through attacks of small-pox or vaccination and the promptness with which vaccination and revaccination are instituted. With typhus fever, too, there existed little chance of preventing spread within a dwelling in which the disease appeared. In exceptionally large houses of the very rich, with ample service, and in two hospitals, the Johns Hopkins Hospital and the Robert Garrett Hospital, with satisfactory provisions for the purpose, early separation of those sick with these affections has undoubtedly on repeated occasions, but by no means invariably, been followed by failure to spread. Otherwise, however, for the diseases under consideration, the sole effect possible to be hoped for is the prevention of their spread to the outside population, by interfering with the outgoing and ingoing of persons and the passage out of materials. In connection with typhoid fever, until the last few years, no measures of isolation of the sick or of protection of those exposed were prescribed either in homes, hospitals, or other institutions. No isolation of cases of pulmonary or other forms of tuberculosis within homes and institutions has ever been advocated by the Baltimore Health Department, and no restriction (except to forbid the handling of food for sale) has been put upon the free movements of those with open tuberculous lesions. Disinfection of sputum has not been required. Since 1905, under the State law, fumigation with formaldehyde gas of the rooms occupied by registered cases of pulmonary tuberculosis has been carried out after death or removal for other cause.

In the early days, houses harboring cases of small-pox and typhus fever were posted with warning signs, and even guards were often placed to prevent ingress and egress. These signs were first posted on premises on which were cases of diphtheria in 1898, and the use of similar signs was instituted for scarlet fever, measles, whooping-cough, chicken-pox, mumps, epidemic meningitis, and poliomyelitis in later years. As late as 1915 this was done, except in cases of diphtheria and scarlet fever, with no regularity.

Small-pox is the only disease for which the health department has consistently practiced removal to hospitals, but in times of considerable epidemics facilities were not at hand to hospitalize half the cases discovered. Cases of typhus fever, during the great prevalence of the disease in the first three quarters of the nineteenth century, were sent to the department's hospitals in large numbers, but apparently more for the better care of the destitute sick than

as a method of disease restriction, for cases were often sent to the open wards of the almshouse infirmary. Since 1900 at least, the rare cases of typhus fever have been hospitalized primarily as a protection to the rest of the community. The relatively small number of beds in the Sydenham Hospital has been adequate to accommodate so small a proportion of the cases of diphtheria, scarlet fever, or measles, occurring within the city, that its use has practically been limited to the care of severe cases of these diseases happening under home conditions particularly unfavorable for treatment. As an isolation hospital in the true sense of the term, it can not for these diseases be said to exist. It has very occasionally been used in this sense for cases of poliomyelitis and epidemic meningitis. Compulsory hospitalization, except very occasionally, has never been practiced in Baltimore for cases of typhoid fever.

It has been shown that the system of school inspection practiced could not by any chance be credited with any material effect in the control of any communicable diseases, except in so far as it assured the enforcement of vaccination and has assisted in the gradual delousing of the population.

That warning signs have exercised a helpful effect in keeping the more enlightened part of the community from contact with cases of communicable diseases is certain, but it is no less certain that they have had no restraining influence upon a considerable section of the population. The same may be said concerning restrictions sought to be imposed upon the inmates of houses harboring communicable diseases from mingling with the neighbors and the public. If the neighbors are in sympathy, they mingle freely; if they are opposed, whether on account of fear or wish to support the law and the authorities, the offenders are reported, and actions are taken by the department to enforce its regulations. It is probable that in some degree more or less serious, the regulations of the health department in regard to household quarantine are broken in at least the majority of instances.

From the beginning, the discharge of patients and contacts from isolation in the case of small-pox and typhus fever has been rather rigidly supervised and controlled by the health department. For other diseases, the discharge was at the discretion of the physician in charge until 1898, when the health department assumed entire charge of the matter through the health wardens. Since 1898, the health warden's certificate has been required of children and teachers returning to school after isolation for small-pox, typhus fever, diphtheria, scarlet fever, measles, mumps, chicken-pox, and whooping-cough. In 1917, epidemic meningitis and poliomyelitis were added to this list. The discharge of cases of diphtheria and of diphtheria carriers since 1896 and of cases of epidemic meningitis and meningo-coccus carriers since 1917 has been controlled by culture tests. In regard to all other diseases, the date of discharge of the recovered and of contacts has been governed in the case of the former by arbitrary and varying standards, and in the case of the latter by the average length of the incubation period. Since 1916, typhoid carriers have been forbidden to prepare or otherwise handle food for others.

The Baltimore health department has never inaugurated a single administrative measure directed at the control of the venereal diseases. Under the regulations of the State Department of Health of 1894, applying to the whole State, cases of ophthalmia of the newborn, commonly gonorrhœal in origin, have been reported, and the department has been active in enforcing prompt treatment, but entirely from the standpoint of restricting blindness. In regard to the

venereal diseases in their usual forms, from either the standpoint of prevention or cure, it has never inaugurated a single activity. An ordinance designed to prevent promiscuous sexual intercourse in boarding and lodging houses, apartments, and hotels was passed in 1918 at the insistence of the United States army officials. Since venereal diseases were made reportable by resolution of the State Board of Health the same year, the Baltimore health department has contented itself with receiving such reports as were made and with lending its power, when called upon, to force a few recalcitrant patients to appear at the venereal-disease clinic established by the United States Government in cooperation with the State Board of Health and at the clinic of the Johns Hopkins Hospital. No effort was made to establish clinics in the department, to enforce the reporting of cases, or to establish any machinery for their oversight. Since 1896, the bacteriological laboratory has examined cover-slip preparations for gono-cocci, and since 1916 it has made Wassermann reaction tests for physicians.

The removal of materials from dwellings and institutions harboring cases of communicable diseases, though probably forbidden by the health department, was not controlled with any certainty until recent years. Since milk has been delivered in bottles, and before 1910 certainly no large proportion of household milk was so delivered, the health department has seen to it that empty milk bottles from " infected " households have not been removed by milk dealers until disinfected under its supervision. Effective restriction on the sending of laundry to washwomen is not possible, but, with the extensive development of public laundries during the last 25 years, on account of the cooperation of these establishments, danger of spreading diseases by means of soiled clothes from such houses has been greatly reduced.

From the foregoing facts it is evident that except for small-pox and typhus fever, so far as the use of methods under consideration are concerned, the Baltimore health department until 1898 or thereabout pursued a " hands off " attitude in regard to the diseases commonly regarded as spread by immediate and mediate contact. It is equally clear that hospitalization of the sick and their contacts, on account of the hopeless deficiency of hospital accommodations and the character of the hospitals used, can have exerted no material influence in checking the spread of any of these diseases when in epidemic form, with the possible exception of small-pox. It must be quite patent, not only to those experienced in public-health administration and to physicians, but to those of the general public who have had experience with the course of anyone of this whole class of diseases under the conditions above described, that the spread of small-pox, typhus fever, diphtheria, scarlatina, measles, whooping-cough, mumps, chicken-pox, and the like from one individual to another is rarely influenced by such isolation of the sick and their contacts in typical homes and institutions. Even in the rare instances in which the diagnosis of the first case is made before all the susceptibles have been exposed, complete separation of the inmates is impossible on physical and personal grounds. Therefore it would appear that, under these conditions, even during the few years since about 1910, that a sustained effort has been made by the health department to enforce isolation of this type, in but a very small proportion of instances under the most favorable conditions can this procedure have restricted the number of cases among susceptibles in the populations exposed in the homes and institutions under consideration. For the same reasons, even early hospitalization of the

first cases can not be expected materially to cut down the number of primary exposures in these groups; in the nature of the case, it can only, so far as these persons are concerned, lessen the risk run of repeated or constant exposure. That the cutting off of communication of the infected in dwellings by quarantine procedures is an effective measure and capable, when complete, of preventing the spread of the causes of the diseases under consideration to the general community must be acknowledged upon *a priori* and experimental grounds. There can be little doubt but that in the case of epidemics of small-pox and typhus fever when dwellings harboring cases of these diseases were adequately watched by reliable guards so that ingress and egress were certainly prevented, this method has been effective. But experience has shown that without trustworthy guards, except among the most intelligent and conscientious portion of the population, on the whole in the minority, complete isolation of the sick and their contacts from the general public is not obtained. It is well known in the health department that certain elements, by no means small in numbers, in the population consistently evade, or attempt to evade, regulations in this regard. However this may be, with the exception of small-pox and typhus fever, this restrictive measure was not seriously attempted in Baltimore for any disease before 1898, when it was first applied to diphtheria, scarlatina, and chicken-pox, to be followed in later years for whooping-cough, measles, mumps, meningitis, and poliomyelitis. It can not be said that it was generally done for all of these diseases before 1916, or that it was ever perfectly enforced for every reported case of any one of them.

In regard to the value of disinfection by fire, heat, and chemicals, it may be said that whatever virtue may reside in these procedures as commonly practiced has been rewarded to Baltimore, for small-pox and typhus fever from early days, for diphtheria, scarlatina, measles, and whooping-cough since about 1900, and for pulmonary tuberculosis since 1905. That formaldehyde disinfection of quarters occupied by the tuberculous, as practiced, could have had any notable influence upon checking the spread of the cause of this disease is beyond the bounds of reason. Only in the last few years has the health department advised disinfection of the discharges of typhoid-fever patients, and it has never had the forces to see that this advice has been consistently followed.

The effect of vaccine inoculation upon the course of small-pox, of typhoid inoculation upon typhoid fever, of anti-rabies inoculation upon hydrophobia, and of diphtheria antitoxin upon diphtheria will be considered in detail in the separate discussion of these diseases. Suffice it to say here that before 1890 vaccination against small-pox was never pushed to the point of affording real protection to the population, that anti-typhoid inoculation has been very little practiced, and that there is evidence that the use of diphtheria antitoxin has materially lessened the fatalities from that disease.

The measures inaugurated about 1912 and brought to a stage of precision by 1916 to prevent the spread of certain diseases from households harboring them by removal, until disinfected, of milk bottles and the like must have served a useful purpose, particularly in regard to diphtheria, scarlatina, and typhoid fever; but even here the protection has not been and probably can never be perfect, for the method can not be put into operation until the cases are reported, and before this is done some days (or even weeks in the case of typhoid fever) have elapsed between the development of the disease and the application of the restrictive measures.

Chapter VII.—Administrative Officers and Subdivisions of the Health Department.

Commissioners of health; Vaccine physicians or health wardens; Division of statistics; Plumbing division; Laboratories; Inspection of school children; Nursing bureau; Bureau of communicable diseases; Bureau of infant welfare; Miscellaneous services. (Tables 7-8.)

THE COMMISSIONERS OF HEALTH.

The early commissioners of health were laymen, and their main duties were to try to keep the city clean and to enforce the nuisance ordinances. Theirs was to act and not to think, and from such records as remain it would seem that they strove earnestly and honestly to perform their tasks. On medical questions, particularly in regard to the management of epidemics, they were advised until 1821 by the health officer of the port, and from this date until 1839 by the consulting physician.

Dr. Thomas E. Bond, consulting physician from 1821 to 1829, was a man of eminence in his profession, and his annual reports reflected the current thought of his time. He established public vaccination.

Dr. Horatio G. Jameson, 1830 to 1835, a student and thinker, and one of the most accomplished physicians and surgeons of his day, was probably the ablest man ever at the head of the department of health of Baltimore. He urged compulsory general vaccination, to be routinely applied in infancy and repeated at puberty. In 1832 he decided that cholera is not contagious in the usually accepted sense and urged that it be fought by a general cleaning up of nuisances and the establishment of a number of free dispensaries where the poor could conveniently obtain prompt treatment while the disease was in the early stages. He bitterly opposed a rigid system of quarantine as unnecessary and hurtful to trade. Yellow fever had ceased to be a menace, diphtheria and scarlet fever had not yet assumed epidemic prevalence in virulent form, typhus fever was comparatively quiescent, and small-pox and malarial fever were regarded as the chief problems. The former was to be controlled by vaccination and the latter by draining and filling low places. Under his direction, and with Dr. Samuel B. Martin as health officer of the port, the Baltimore health department was, relatively speaking, at its zenith.

Dr. John Hanson Briscoe and Dr. Robert A. Durkee, consulting physicians, 1836 to 1838 and 1842 to 1844, respectively, left no evidences of particular talent or activity.

With the revival of the board of health with medical representatives in 1839, Dr. Thomas E. Bond became the first president and executive officer. He was succeeded by Dr. Charles E. Davis in 1840 and 1841. With its reestablishment in 1845, the presidency of the board was held for six years by Dr. William T. Leonard, who was succeeded by Dr. S. R. Clark, 1851 to 1852. Dr. Leonard was a man of some ability and was particularly active in pushing vaccination.

Dr. William H. Kemp, as commissioner of health and city physician, was the head of the department from 1853 to 1860. During the yellow-fever epidemic in the cities at the mouth of the Chesapeake, he kept up open communication and received refugees. He played an important rôle in the National Congress on Quarantine held in 1856.

Of the next three commissioners at the head of the department, Dr. Charles H. Bradford, 1861, Dr. S. T. Knight, 1862 to 1864, and Dr. G. E. Morgan, 1865 to 1870, Knight was the only one of more than ordinary ability, and no one of them made any signal improvement in methods or measures.

Dr. Milton N. Taylor, 1870 to 1871, a respectable and amiable practitioner, showed no powers as an administrator; but his reports give evidence of a broader outlook upon matters relating to environmental conditions, for he advocated the establishment of numerous small parks in congested districts as breathing-spaces for the poor and the planting of trees throughout the city to afford shade in the hot weather and as a means of reducing surface and ground water.

Dr. George W. Benson was commissioner of health in 1872 and 1873 and in 1882 and 1883, when it fell to his lot to fight two of the most severe epidemics of small-pox in the history of the city. He was a vigorous and determined administrator and left the most complete and accurate records of vaccinations and of reported cases to be found in the reports.

Dr. James A. Steuart, who was in charge of the department as commissioner of health from 1873 to 1889, with the exception of the two years 1882 and 1883, devoted most of his time and energies to the work. With an attractive personality, a high standing in the medical profession and in the community, and a decided taste for the work, and being well read in the literature of hygiene of his day, he possessed many of the qualifications for leadership in public-health administration. However, his deficiency in the requisite knowledge of the natural sciences and of pathological anatomy and his inability to comprehend the rapidly growing literature of micro-parasitology were handicaps that prevented his rising to the full height of his opportunities. Thoroughly convinced that most of the communicable diseases are due to gaseous emanations from putrefactive processes, early in his adminstration he fell a complete convert to the sewer-gas theory of disease causation, and he busied himself chiefly with increasing the machinery of the department to deal with common nuisances, which were multiplying in geometric ratio to the growth of the population. In this field, his greatest contribution was the establishment of plumbing inspection and the employment of chemists to examine market milk and well and spring waters. He had a decided interest in vital statistics, secured an ordinance requiring the certification of deaths and of births, and was very successful in having the latter recorded. It was during his administration that there was begun the compilation and publication in the annual reports of elaborate statistical tables of deaths expressed in absolute figures. Dr. Steuart laid considerable stress upon the use of statistics in administration. Curiously enough, he made no consistent effort to secure the reporting of cases of communicable diseases.

Dr. Steuart was succeeded by Dr. George F. Rohe, 1890 to 1892, a man of considerable talent, force, and executive ability, combined with a good training

in medicine and a taste for hygiene, on which he wrote a small text-book. Rohe's reports showed a decided grasp of public-health problems, and that he did not retain office was a distinct misfortune to the city and to the cause of public health in general. Had he continued in office a few more years the city would have gained at least 10 years in progress.

Rohe was succeeded by Dr. James F. McShane, a man of more than average native ability, but of defective training in the natural sciences and in medicine, and but little acquainted with the literature of his subject. He had had the advantage, however, of some years' experience as assistant commissioner under Steuart and Rohe, from whom he evidently absorbed some ideas. McShane was open to suggestions from the leaders in the medical profession, and his administration, 1892 to 1897, was marked by the establishment of the laboratories of chemistry and bacteriology in the department and by the recognition of the importance of reporting communicable diseases. He appreciated the necessity of changing the traditional methods of the department. He made some investigations into the epidemiology of typhoid fever and recognized that it may be spread in a variety of ways. He early recognized the value of diphtheria antitoxin and secured its use free of charge to those unable to pay for it. He had no ideas of his own, did not inspire confidence, and completely failed to attain a position of leadership at a time when the leadership of a commissioner of force, talent, and broad knowledge would have been of the highest value to the city.

Dr. C. Hampson Jones succeeded to the commissionership in 1898 and brought to the office native talent and a real interest in public-health administration, but unfortunately, like Rohe, he held the office for two years only, a time too short to reorganize the methods and to change the attitude of the department very materially. Fortunately for the department, he was retained as assistant commissioner from 1900 to 1915 and was reappointed commissioner in the fall of 1919.

Dr. James Bosley was commissioner of health from 1900 until his death in 1913. A man of considerable personal charm and a physician of good repute with a large general practice, but untrained in pathology and in microparasitology at a time when these branches dominated the whole field of hygiene, and unacquainted with the literature of hygiene, he was almost entirely lacking in the qualifications necessary for the proper filling of his office. He was generally beloved in the department, in which in a short time he became little more than a figurehead. His unexpired term, from January 1913 to October 1915 was filled by Dr. Nathan N. Gorter, a surgeon of good social and professional standing, who was a conscientious official with high aspirations and ever anxious to improve the scope and efficiency of the health department. Without distinct ability as an administrator or any special knowledge of hygiene and the problems pressing for solution, he exercised no influence of lasting importance in the department.

For the 18 years 1897 to 1915, as commissioner and assistant commissioner, Dr. Jones was the real force in the department, and the changes in the attitude and the innovations in measures that marked this critical period were very clearly his contributions. In many matters he derived help from the expert knowledge of his colleague, Dr. Stokes. Dr. Jones was handicapped by lack of direct

authority in the department and had to address the city authorities through the medium of the commissioner. He had to do the work of incompetent commissioners as well as his own, much of the time without adequate and trained assistance. In consequence, organization of the department was incomplete, and measures and methods formulated constantly fell short of his plans. Given a free hand, with his intimate knowledge gained by long experience and hard study of the needs of the department, Dr. Jones might have accomplished much more than the very considerable reformations he instituted.

The last commissioner of health serving during the period under review was Dr. John D. Blake, whose term of office covered the four-year period ending in October 1919. Dr. Blake, who was a physician and surgeon of wide experience, accepted office at a relatively advanced age. Of a genial nature, and with a strict sense of justice and probity, Dr. Blake evinced a sincere desire to devote himself to the public service. Like so many of his predecessors, however, he was untrained in public-health administration, lacking in first-hand knowledge of micro-parasitology, and not well versed in the literature and methods of modern hygiene. Though considerable advances in the methods and scope of the work of the department were made during his administration and he was ever ready to consider suggestions, these handicaps seriously impeded the reorganizations and readjustments indicated by present-day knowledge.

The main object of this review will be missed if it has not been made apparent that the chief factor determining the activities and accomplishments of the health department, or, in other words, its actual value to the city, has been the fitness of the chief medical officers. A man of high talent, sound judgment, and accurate and comprehensive knowledge to formulate appropriate policies, and force of character to impress them on the authorities, the profession, and the general public and gain the power to carry them out, is a tower of strength as the head of a health department. Such a one has been rare. Jameson was the only man long at the head of the Baltimore health department who met these qualifications in any high degree. Rohe might have reached them in considerable degree had he remained longer in office. The most amiable and earnest commissioner, lacking in knowledge and in capacity and desire to learn, may, with the best intentions, set back the clock for years. On the other hand, most of the men at the head of the health department were, on the whole, about as useful and capable as any who could have been got to serve under the conditions obtaining.

A great drag on the logical development of an intelligent and adequate public-health administration in Baltimore has been the indifference, except in times of great epidemics, of the public and of the administrative and legislative authorities at certain periods of the city's history, and this has been influenced to a certain degree by the periods of excessive immigration. The dilution of civic solidarity by the influx of people of lower standards of intelligence, education, and living conditions must always not only increase the problems but decrease the effectiveness of administration. The continuity of plans and of their development is broken by the necessity of meeting new and sudden demands, and the influence of the more progressive and intelligent leaders among the older citizenship is diffused over a larger and less ductile mass and consequently lessened. The disgraceful years of rioting, interference with

voting by bands of "plug-uglies," and the weak and corrupt civic administration of the fifth and sixth decades of the last century were intimately associated with such a period of massive immigration. The military government during the Civil War, the great losses to business and commerce associated with that war and its consequences, and the long period of political corruption and of administrative inefficiency that followed, reacted on public-health administration. The general apathy of the public to sanitary improvements is well illustrated by the attitude toward establishing a system of sanitary sewers, repeatedly proposed, and toward the water-supply. During these periods only men of extraordinary power could have exerted a decided influence in the health office. Another great setback in one sense, but of some general sanitary gain in another, was the great fire of 1904. The energies of mayors of a type decidedly above their immediate predecessors, which might have been devoted to sanitary reforms and the placing of stronger men in the health department, were thus diverted to other directions.

While many of the mayors of Baltimore were men of distinct ability and none of them were lacking in concern for the general welfare, it is a fact of importance that comparatively few of them evinced a continuing interest in and a critical insight into the problems of public-health administration. Of those who exhibited these qualities, Dr. Edward Johnson, 1818 to 1822, and Mr. James H. Preston, 1911 to 1919, stand out conspicuously. The former was deeply concerned in the measures for the restriction of yellow fever and malaria.

Another serious drag on development of ideas and improvement in measures and methods in the health department was the distinct lowering of the standard of the medical profession of the city after 1870, traceable to the growth and influence of the proprietary medical schools that flourished between 1872 and 1910. Many of the medical graduates turned out were for their times relatively much inferior in intellect, general and professional education, and standards than the men whom they replaced.

SUBORDINATES IN THE HEALTH DEPARTMENT.

While in the early years subordinates in the health department may have been carefully selected for personal fitness for their work, there is nothing in the records to show that this was generally true. So far as tradition goes, with a few exceptions, appointments to all offices from commissioner down have been governed by partisan politics. Of late years reformers and aspirants for political advancement have dwelt upon this point, and it has been freely acknowledged by the professional politicians. The professional politicians, in a sense, act as employment agencies; but, unlike the usual agencies for this purpose, they assume a double responsibility, for they must to a considerable degree look out for the interests of both employer and employee. The usual business agency is interested primarily in getting a job for the employee, but the politicians have a direct interest in seeing that, to some degree at least, the employer is not illy served. The history of the health department shows that a large number of employees, appointed primarily on political grounds, have been faithful, conscientious, hard-working, and intelligent servants of the public for years, with a commendable pride in their work, at which, in times of stress, they have slaved for long hours overtime without a murmur, without

any chance of extra pay, and without public recognition. For many years, for positions requiring technical skill and training, as the heads of the laboratories of chemistry and bacteriology, for instance, the incumbents have been chosen primarily for these qualities. Many valuable assistants have been trained in these laboratories from promising material and given the chance of advancement to higher posts on pure merit. Some of them have been called away to more remunerative positions in industries and made way for others to rise in their places. The heads of the division of plumbing have always been master plumbers of honesty and capacity and have so conducted the work that dishonesty soon becomes glaring and meets its just reward and shirkers are crowded out.

That there were many incompetents and a considerable number of misfits there is no question, but actual practical work in the department was the only school available to subordinate employees, and only the few can grasp the details of new labors without careful oversight and instruction, and under no system of appointment will the lazy exert themselves without prodding. Where subordinates have this treatment from an immediate superior, backed by the commissioner, good service to the city has commonly resulted.

The defects in the administration of the health department are not explained satisfactorily on the common assumption that they were due in the main to the inefficiency of subordinates steeped in partisan politics and forced on an unwilling commissioner by political bosses. To a degree not generally recognized, the commissioners have been responsible for these short comings. It is the duty of a commissioner of health to set policies and standards, to train his personnel, and to see that the work is done promptly and affectively, that misfits —unavoidable under any system of appointment—are properly placed, and that the incompetent and the shirker are weeded out. Too often has a commissioner failed in one or more of these respects and it has fallen to the lot of the assistant commissioner, without power to inaugurate or to change policies and to promote or demote subordinates, to attempt to discharge the duties of two men.

THE VACCINE PHYSICIAN AND THE HEALTH-WARDEN SYSTEM.

In 1821, in order "to extend the benefits of vaccination" to the poor and probably with the design of relieving the members of the Medical and Chirurgical Faculty of a burden which they had voluntarily assumed, an appropriation of $400 was made by the city for the appointment in the health department of four public vaccinators to be called vaccine physicians. The system was organized and the physicians were chosen by a committee of the faculty. As at first intended and practiced, there was no compulsion exercised on the public to submit to vaccination by these four physicians; their services were freely extended to those who desired them but who could not afford to pay the charges of private practitioners. The vaccinators made monthly reports to the health department of the number of vaccinations made and of their success or failure. It was not until the small-pox epidemic of 1831 that, in addition to their original duties and as part of the administrative program of the department against this disease, they were ordered to vaccinate, *nolens volens,* the contacts of cases

of small-pox and were detailed to make a house-to-house canvas for hidden cases. In 1827, the number of vaccinators was raised to six and in 1831 it was doubled, one for each city ward.

By ordinance of 1853, it was made the additional duty of the vaccine physicians to be on the outlook for cases of any "pestilential" disease and for nuisances dangerous to health in their wards, which they were to report to the health office. By the charter of 1900, a vaccine physician for each ward was prescribed, who, in addition to his other duties, was to act as health warden, and thus the vaccine physicians were raised officially to the status of wardens of health. Their duties were very much expanded in the eighth decade of the last century, when vaccination was made compulsory and an ever-increasing proportion of the people availed themselves of the privilege, now extended to every one, of free vaccination. When the street-cleaning and garbage and ash removal were taken out of the health department and its nuisance force was thereby cut down to a minimum, the health warden gradually evolved from a reporter to an abater of nuisances of various sorts. The health wardens were relieved of some of the latter duties by the inspectors of nuisances until 1895, but from this date until 1916 the chief function of the health warden was the control of ordinary nuisances, and, in many wards, the inspection of cellars, yards, toilets, privies, leaking pipes and rain gutters, and dirty and ill-paved yards, alleys, and streets obscured their medical activities. The latter were much expanded during and after the commissionership of Dr. C. Hampson Jones in 1898, when concerted efforts, very largely carried out by the health wardens, were instituted against various communicable diseases.

Since 1916, the nuisance work of the health warden has been considerably abridged, partly because of the improved grading and paving of streets and alleys and the completion of the dual sewage system, and partly because of the shifting of most of it to the division of plumbing. He has in consequence been restored to his original status of medical officer of health in his ward, in charge, under the direction of an assistant commissioner of health, of public vaccination and of other activities directed to the control of diseases transmissible by personal contact. To this end he must visit each reported case, give instructions, establish isolation in homes and institutions, take cultures, make diagnoses, issue discharge certificates, and obtain and file a history of each case.

The vaccine physicians and health wardens always have been physicians in active practice, giving so much of their time to the work of the department as was demanded. Their salary has always been incommensurate to the time devoted and the character of the services rendered, and, owing to lack of proper organization of the work of the department, much of their time has been wasted unnecessarily.

The health wardens and the system have been much criticized and maligned, particularly by the unthinking and the uninformed of a class that, recognizing that something was radically wrong with the department and believing that all the evils affecting mankind center in the nuisances the health wardens were supposed to abate (an impossible task under the physical conditions obtaining), laid the defects at their door. As a matter of fact, the typical vaccine physician or health warden has always been a physician of more than the average intelligence, training, diagnostic ability, and knowledge of the natural history of

disease, and certainly, in knowledge and experience in his work, the superior of any commissioner of health between 1900 and 1919. Many able physicians, such as G. W. Miltenberger, Frank Donaldson, Charles Frick, William F. Lockwood, N. G. B. Iglehard, for instance, who afterwards reached distinction, did not scorn the office in their earlier years.

DIVISION OF STATISTICS.

Since the establishment of the health department the records of deaths, since 1875 the records of births, and since 1882 the records of reported cases, have been kept by clerks under the supervision of the chief medical officer. For many years the records of births, and deaths, and cases have been kept and tabulated in separate divisions. In both form and content the general and special tabulations published in the annual reports have been directed and supervised by the commissioners or by the assistant commissioners of health. Neither the statistical clerks nor their supervisors have had formal training in statistical methods and their competence has not extended beyond the capacity to follow with conscientious fidelity the customs and rules of classification of deaths, births, and reported cases, to perform addition correctly, to set up simple tables, and to calculate crude rates.

DIVISION OF PLUMBING.

When supervision of plumbing was first provided for in 1883, with provision for an inspector with power to frame proper rules therefor, subject to the approval of the Board of Health, the evident intent of the law was to limit operations to new installations. But the inspector soon found many nuisances in connection with old installations, which were reached under the general powers of the board. These nuisances were associated chiefly with poor design and materials and lack of repair, giving rise to odors, leaks, and overflows, both within and without dwellings. These conditions and their causes and proper remedies were ably treated and illustrated with drawings by the inspector of plumbing, John W. Lee, in his report for 1886. Among other things he found to condemn were lack of vents for privy-wells, the filthy condition of water-closets and bath-tubs, often inclosed with foul-smelling and rotten woodwork, and the use of the old pan type of water-closet. Strongly convinced of the potency of sewer-gas as the prime cause of acute diseases, and backed by a commissioner wedded to this theory, he set to work to rectify these conditions. From the beginning, therefore, the activities of the plumbing division have been to regulate and correct existing nuisances by ordering, where deemed necessary, repairs or renewals amounting to new installations, to see to it that all new installations were in design, material, and workmanship proper for their purpose. These factors, of course, led to the establishment of standards on which permits for work were based, and of a system of inspection of work in progress to see that these standards were met.

It is a matter of interest that the plumbing department has sought to protect the property-holder by insisting that plumbing work shall be done in a "workman-like" manner, that is, according to the standards of ethics and practice recognized as proper in the trade. A second activity of importance was the

system of inspection of complaints, involving advice and requirements for the abatement of nuisances connected with plumbing, and covering a great variety of conditions. A third duty was the clearing of stoppages of public and private sewers, and to a certain degree the oversight of cesspools. By 1898 the duties and standards of the plumbing department had reached a point where the commissioner of health felt warranted in issuing a set of rules and regulations, which had the effect of a code of plumbing. The section on plumbing of the building code of 1908 represents an expansion of these regulations.

With the partial completion of the new sewage system in 1911, the work of the division of plumbing was enormously increased, and the personnel was correspondingly expanded, to force and to oversee connections. The sewer laterals were extended to the building-line of each property, and all connections thereto were made under the supervision of the division of plumbing. This work, which required an immense amount of detailed planning and supervision and considerable executive ability, was pushed when the sewers were ready for connections and was successfully completed for the sewered districts in 1918.

The annual reports and observation of their work and methods show that the successive chief inspectors of plumbing have been faithful public servants, men of integrity, judgment, and courage, who have well filled positions of responsibility.

LABORATORIES.

The establishment of the laboratories of chemistry and of bacteriology in the health department dates from 1896. Though started under different conditions and maintained always as separate departments, their work, while remaining separate and distinct in certain fields of activity, soon became closely interwoven.

CHEMICAL LABORATORY.

The laboratory of chemistry evolved by slow stages, under the needs of the commissioners of health for expert advice and assistance in attempts to improve and control the milk and water supplies. This began with the employment of Professor William P. Tonry, of the Maryland Institute, by Commissioner Steuart, to examine samples of milk in 1873 and of well and spring waters in 1876 and 1885. As a result of these examinations, Commissioner Steuart started a campaign against city wells in 1876. In 1892, Commissioner McShane employed another chemist, Professor P. D. Wilson, to conduct examinations of the waters of streams tributary to the Lake Roland water-supply.

Though Professor Tonry's valuable reports on the milk supply in 1873 showed that much of the milk was deficient in butter fats, watered, and filled with impurities, no steps were taken by the city government to furnish the commissioner of health with means and personnel to enforce the weak ordinance of 1855 and the similar ordinance of 1879, forbidding the mixing of water and any drug with milk offered for sale.

Dr. Tonry was appointed chemist to the health department in 1894, under the provisions of the food ordinance of that year. He used his private laboratory until 1896, when provision for a small chemical laboratory in the health department was made. Dr. Tonry made a comprehensive study of the sources of the Baltimore milk-supply, the conditions under which it was produced, handled,

and sold, and started a system of inspection to prevent adulteration by addition of water, adulterants, and preservatives. An important part of his work was the organization of inspection and improvement of cow stables, and the feeding of milch cattle, which finally, by making it unprofitable, served to force most of these places to discontinue operations. Examination of well and spring waters was inaugurated, and of preserved foods, to which suspicion was directed.

In 1895, the cause of the sudden illness of 17 people was proven to be due to arsenic present in a barrel of pickles sold at a grocery.

The reports of Dr. George W. Lehmann, who succeeded Professor Tonry in 1896, show that creditable work was done in inspection and analysis of the milk and water supplies. In 1896, the work of food inspection was expanded by adding inspection of bakeries and confectioneries, and in 1900 this inspection was extended to markets and slaughter-houses, resulting in the condemnation of large quantities of meats and vegetables as unfit for food.

By the gradual addition of inspectors and the reference to them by the commissioner of health, usually on complaint of citizens, of different types of food for examination, the chemist became the head of an administrative department, guarding the purity of the food-supply. Where legal standards established by ordinance or by state legislature were lacking, they were supplied by ukase of the commissioners of health. The reports of chemical determinations and of inspections and condemnations made are full and, for the purposes of sanitary administration, very informing. In 1903, an extensive inquiry was made into the adulteration of milk sold in small stores, particularly for the use of the babies of the poor, and into the quality and composition of condensed milk used for this purpose. It was calculated, from the number of cans of the latter sold, that at least 960,000 gallons of this material in the dilutions recommended by the manufacturer were used each year in the city. Pus organisms and other bacteria being present in numbers in samples from original packages, and the chemical analysis showing evidences of adulteration, standards of purity for condensed milk were set and enforced.

The activities of the department had been expended by 1910 to include inspection of dairy farms supplying milk to the city and supervision of the pasteurization of milk and cream (a considerable number of dealers having voluntarily adopted pasteurization), better control of the physical conditions under which milk was handled and sold (especially the general sanitation of small milk shops), and the inspection of meats and meat products at slaughter-houses. At the same time, the chemical analysis of foods and drugs for adulteration had expanded.

By 1915 the chemist presided over a bureau of chemistry and food inspection, with several assistants and a large force of inspectors. There were analyzed regularly the city water, the milk, cream, ice-cream, condensed milk, canned and prepared foods, and the like. Dairy farms, dairies, milk-wagons, slaughter-houses, wholesale and retail markets, stores, bakeries, and confectioneries were inspected and pasteurization of milk was supervised. The scope of the meat and dairy and milk inspection and of the water control are considered in other chapters.

The most useful work of this division of the health department has undoubtedly been in connection with water and milk, and of all the activities in this

relation, the enforcement of the milk ordinance of 1917 was perhaps its most significant accomplishment of value. Viewing this work from the standpoints of its possible, probable, and known benefit to the public health, it does not appear that much has been accomplished through the system of dairy-farm inspection. In adopting it and in relying too heavily upon it, the department followed the fashion of the time. Much more would have been accomplished with the same force in guarding the milk-supply after its receipt within the city.

The progress of correcting the evils connected with the milk-supply, while slow, was in the end effective, and each advancing step accomplished something of value in the direction of safeguarding the public health. To those unfamiliar with the complex forces, both static and dynamic, within and without the city, to be overcome at each step, appreciation of the full value of these services is impossible.

In its work, the division or bureau of chemistry has worked in active cooperation with the bacteriological laboratory.

BACTERIOLOGICAL LABORATORY.

This laboratory was established in 1896, on the recommendation of Commissioner McShane, supported by a committee of the Medical and Chirurgical Faculty. The immediate stimulus was the recent discovery of the diphtheria antitoxin and of the culture method for the certain and rapid diagnosis of diphtheria. Dr. William Royal Stokes has served continuously as bacteriologist. This laboratory from the first offered physicians the services of bacteriological methods for the rapid diagnosis of diphtheria, pulmonary and other forms of tuberculosis, malaria, gonorrhœa, and certain other affections, and later, as methods were introduced, of typhoid fever, rabies, meningitis, poliomyelitis, pneumonia, and syphilis. This laboratory has never produced diphtheria and tetanus antitoxin and other antisera, nor vaccine virus, but has prepared antityphoid vaccine in large quantities. Dr. Stokes early turned his attention to bacteriological analyses of the water-supply and of the milk of Baltimore, and independently and in collaboration with the chemist, he has made extensive and valuable studies of these. The annual reports from this laboratory contain accounts of creditable studies and interpretations of their relation to public health in Baltimore. Among the studies of greatest value are those relating to the water-supply, particularly the introduction and control of chlorinization in 1911, and the investigations of the presence of pus and of pathogenic organisms in milk, especially in relation to inflammatory mastitis and tuberculosis of milch cattle. The large scale on which diphtheria-culture tests are used in the bureau of communicable diseases for release and detection of possible carriers in institutions, schools, and homes, was made possible through Dr. Stokes's cooperation and largely on his suggestions.

Throughout its history the bacteriological laboratory has offered diagnostic and other services far in advance of their utilization by the medical profession and the public, and judged by the character of its accomplishment, within the limitations in means and personnel allowed it by the city government, it compares favorably with that of any other city.

SCHOOL INSPECTION.

School inspection started in 1905 with 2 physicians and 1 trained nurse. Beginning in 1906 with 5 physicians and 5 nurses, medical inspection of school children, at first confined to the public schools, was soon extended to the parochial and to some of the private schools, and as a routine matter it has been limited to children of kindergarten age and of the first four grades of grammar schools. The routine inspections have always been restricted to physical defects, cleanliness, and evidences of successful vaccination. The city is divided into five districts, embracing approximately the same number and type of schools and pupils, and a physician and nurse are assigned permanently to a particular district. The physicians are allowed considerable latitude as to methods, but they use the same record forms. The usual procedure, starting in the fall, is for the nurse to go through the lower grades to inspect first for evidences of successful vaccination and for vermin. Her attention is called by the teachers to those children who obviously are defective in seeing, hearing, breathing, or who in any other way seem abnormal, and in addition the nurse looks and inquires for children with chronic coughs, anemia, and the like. All children lacking evidences of vaccination, or who have or are suspected of having defects, are brought before the school physician at his morning visit, which lasts from one to three or more hours each school day until all the examinations are completed.

The examinations are confined practically to physical inspection—head, eyes, ears, nose, throat, neck, and extremities. Only exceptionally do they go further and embrace examination of the chest for diseases of the heart and lungs. Where acute febrile disease is evident or suspected, the temperature and the pulse-rate may be taken. No routine examination is made for the acute diseases of childhood. No medical treatment is prescribed or given by the physicians. Exclusion is ordered for lack of evidence of successful vaccination, for vermin, impetigo, sore throat, and the usual contactive diseases of childhood when discovered. Cards recording the cause for exclusion are sent to the parents, and the health department is notified of cases falling under the list of reportable diseases. In cases of defects or diseases of the eyes, ears, nose, tonsils, and teeth, and of evident anemia or suspected tuberculosis, and the like, the parents are advised to consult the family physician or an appropriate dispensary service. In a large proportion of cases of the latter group, nothing is done unless the children are followed up in their homes by the nurse, and the mother is besought to seek medical advice. Children with defects of eyes, ears, nose, throat, and teeth are often taken in parties by the nurse to the dispensaries for examination and treatment. In many cases of children infested by vermin, usually head and body lice and scabies, the nurse applies the appropriate remedies in the home, often, of course, finding it necessary to treat the whole family. In 1917 the number of school nurses was doubled.

The physicians have returned each year reports with lists of the numbers of pupils examined and the number of defective and those instances in which each of the more usual defects were found. These data are sometimes given in some districts for each separate school. The percentage of defects found vary widely in the various schools. Taking Dr. H. Warren Buckler's report for 1908 as an example of 20 schools, the lowest and highest percentages of defec-

tives were 22.9 and 49 respectively. Under the various headings, the highest and lowest percentages were as shown in table 7.

To take another year as an example, tables are given in the report of 1911

TABLE 7.

Defects.	Highest percentage.	Lowest percentage.
Eye and ear	12.3	3.0
Nose and throat	24.7	7.0
Communicable parasitic diseases	20.3	1.0
Filth	8.1	0.0
Malnutrition	9.0	0.0
Imperfect teeth	36.9	6.5
Unvaccinated	2.4	0.0

showing the total number of pupils examined in the public and parochial schools and the number of instances in which various "defects" were recorded.

TABLE 8.—*Number and proportion of children with defects and diseases, compiled from the Annual Report of the Health Department of Baltimore,* 1911.

Affection.	White.	Percentage affected.	Colored.	Percentage affected.	Total.	Percentage affected.
No. of pupils	47,401	....	5,318	....	52,719	....
Sick and disordered, all causes	24,509	51.71	2,378	44.72	26,887	51.00
No. unvaccinated	2,392	5.05	210	3.95	2,602	4.94
Pediculosis	4,377	9.23	103	1.94	4,480	8.50
Adenoids	3,435	7.25	319	6.00	3,754	7.12
Rhinitis	980	2.07	128	2.41	1,108	2.10
Enlarged tonsils	4,761	10.04	522	9.82	5,283	10.02
Eye strain	1,752	3.70	210	3.95	1,962	3.72
Total eye defects	3,045	6.42	347	6.53	3,392	6.43
Ear defects	263	0.55	21	0.39	284	0.54
Teeth defects	7,056	14.89	794	14.93	7,850	14.89
Adenitis (cervical lymph-glands enlarged)	797	1.68	103	1.94	900	1.71
Tuberculosis, various organs	64	0.14	20	0.38	84	0.16
Mentally defective	254	0.54	21	0.39	275	0.52
Debility	617	1.30	49	0.92	666	1.26

Table 8 must be interpreted with care. It is evident that some pupils have more than one "defect." The high proportion of cases of pediculosis, the greater number of which occurring among whites, was due to the fact that in some of the white schools many or most of the children were so affected, while in most of the white schools none of the pupils were infested. The text of the reports shows that only in certain schools were there instances of pediculosis, and from these it was difficult to eradicate it, owing to the habits of the people. Pediculosis among the whites, except for accidental infestion arising in school

contact, was confined to certain races of more recent immigration. In a few years, through the effective work of the school nurses, the schools were practically rid of this affection. For the other defects, these figures, except for the category of mental deficiency, probably give an accurate picture of their distribution in the population under consideration. Some of the most common defects noted occur together frequently, such as enlarged tonsils, adenoids, rhinitis, and enlarged cervical lymph-glands. These perhaps might be grouped together without serious error as affecting between 5 and 7 per cent of the whole number of pupils. The most important categories are the large proportion of cases of eye-strain and other abnormalities of the eyes (3.72 per cent and 6.43 per cent, respectively) and of children with defective permanent teeth (14.89 per cent). Upon these, pediculosis, and vaccination, the inspectors and nurses very properly concentrate their attention, and under very considerable difficulties, at first interposed on the part of the parents, the children, and even some of the teachers, great progress has been made. This advance has been less satisfactory in connection with teeth, because of lack of a sufficient number of dental clinics in the schools. It is probable that many children whose parents were able to afford it have been induced to consult dentists in private practice, but so great was the need for treatment among children of the poorer classes that the free dental clinics in connection with the dental schools of the city are still unable to cope with the situation. A few dental clinics have been set up in some of the schools where most needed, apparatus and services being donated by dentists, and money contributed by parents' associations and other organizations. This important field of child hygiene has, however, hardly been touched.

In regard to adenoids and enlarged tonsils, the school inspectors, all of whom are experienced practitioners of medicine, have sustained a judicious attitude, advocating removal only in those cases in which it was reasonable to think that improvement would ensue. While the inspectors determined which cases should seek medical or surgical attention, the ultimate decision lay with the parents and the family or the dispensary physician. The small number of cases of evident tuberculosis enumerated do not represent the true number of cases of clinical tuberculosis among the Baltimore school children, for the examinations given are far too incomplete to lead to the discovery of any except the most obvious cases. Nor does the group of mentally defective give a true picture of the situation. The cases enumerated probably include only the evident idiots and a certain proportion of the more backward children, for neither the inspectors nor the school-teachers applied the more refined methods of diagnosis. The small proportion of unvaccinated children (4.94 per cent) speaks well for the success of the efforts of the health department to enforce the vaccination ordinance in late years. The item "debility" stands for malnutrition or undernourishment, and, according to the reports of the inspectors, this is very unevenly distributed among the schools and is largely confined to the children of recent immigrants of certain race-stocks. According to the reports of the inspectors and nurses, this condition among the children of the public and parochial schools is due much more to lack of proper kinds and choice of foods and to methods of their preparation than to lack of ability of the parents to purchase food. It is of interest that, under the most important categories, the

negroes compare not unfavorably with the whites, and on the whole show a smaller proportion of defectives.

During the year under review there were brought to the attention of the inspectors and nurses only 11 cases of the ordinary communicable diseases of childhood: Mumps 8 cases, and diphtheria, measles, and chicken-pox 1 case each. This emphasizes the fact that the inspection is discontinuous, the relatively small inspection forces, owing to lack of time, ordinarily visiting a particular school but twice a year—the second inspection to examine children absent at the first. Only in exceptional instances of considerable outbreaks of diphtheria, scarlet fever, measles, mumps, or chicken-pox have the school inspectors been detailed thoroughly to investigate the children in particular schools for cases of such diseases. In other words, the school-inspection system was not designed, nor was it ever adequate, for the purpose of seeking to prevent or control outbreaks of "zymotic" disease.

The school-inspection system is quite independent of the school board and no reports are made to it. The board of estimates appropriates money aunually to the commissioner of health for salaries for so many school inspectors or school nurses, and the commissioner of health, under his general powers, institutes a system of inspection in the schools. The school board, its officers, and teachers happen to be in sympathy with the movement and actively cooperate, but whatever their attitude, they could at most interfere only with the smoothness of the work. The inspection system has been of very great value, and that it has not been of greater value is due to the fact that means have not been supplied to develop the leads it has disclosed. If its only accomplishment had been the supervision of vaccination enforcement it would have paid for itself many times. In addition, it has resulted in ridding the school children of lice and has caused great numbers of children to have their eyes, teeth, throats, and noses properly cared for. Indirectly, it has resulted in cleaner and better ventilated and lighted schools, and the instruction of both teachers and children in the elements of personal hygiene. It has gathered valuable information, on which could be based a system of inspection and relief meeting the demands of the local situation.

THE BUREAU OF NURSING.

The use of the trained nurse in the health department developed in a haphazard manner from small beginnings. One nurse was appointed in 1905, in connection with the inspection of school-children. The number was increased to 5 in 1906, to 10 in 1917 and to 18 in 1920. A division of tuberculosis nurses was created in 1910, with 14 field nurses and a superintendent. This number was raised to 16 in 1912, to 20 in 1917 and to 26 in 1920. Nurses devoted their whole time to this work.

In 1917, 3 extra nurses were detailed for special services in connection with cases of diphtheria, scarlet and typhoid fevers, and whooping-cough, and in 1919 a fourth corps of nurses was appointed to services in the bureau of maternity and infant welfare. In 1918, the disciplinary and field work of the whole nursing force was placed in charge of a superintendent of nurses, and in 1920 a separate bureau of nurses was established with a total force of 83 nurses.

The superintendent of nurses has always directed the nursing work in connection with tuberculosis, but the other nurses work under the direction of and render reports to the medical officials of the various services to which they are assigned.

BUREAU OF COMMUNICABLE DISEASES.

This bureau, established in 1917, has charge of the activities of the department in respect to the supervision and restriction of persons with communicable diseases, except tuberculosis. The chief of the bureau is the epidemiologist of the department, receives the reports, histories, and other records of cases and directs the work of the health wardens and corps of nurses, particularly in regard to the isolation, hospitalization and release of cases and of contacts. His services as diagnostician are available in doubtful cases. Before the establishment of this bureau these activities were supervised by the single assistant commissioner of health as and when he could find time from other duties.

BUREAU OF CHILD WELFARE.

This bureau was established in 1919, and as its work is almost entirely new, it can have exercised no significant influence upon morbidity and mortality during the period covered in this work. Besides the oversight of midwives, foundling and orphan asylums, boarding homes, and other institutions caring for young children, the bureau conducts 2 obstetrical and 4 prenatal chinics and a day nursery. An important feature of the work is a complete history of each baby.

MISCELLANEOUS SERVICES.

For many years the city morgue, potter's field, and the city post mortem physicians have been under the health department. The department has from the beginning supervised the destruction of clothes, bedding, and other effects of individuals with small-pox. Since 1905 a separate service has been conducted for the fumigation with formaldehyde gas of houses harboring cases of pulmonary tuberculosis, small-pox, diphtheria, and scarlet and typhus fevers, and for sterilization by steam or the destruction by fire, when desired, of articles of clothing and bedding after recovery or death of individuals with these diseases. At various times there have been sanitary inspectors for general nuisances and for tenements and boarding-houses.

PART IV.—POPULATION AND STATISTICAL DATA.

CHAPTER VIII.

1. Population: Rate of growth; Racial composition; Distribution by numbers, sex, and race. (Tables 9 to 13, graph 1.)
2. Natality: Living births; still-births. (Tables 10 to 15, 124, 126, 132.)

POPULATION.

Since the questions of the growth and racial composition of the population involve factors that affected the sanitary conditions and the variations in the resistance and susceptibility of the inhabitants to certain diseases, and, in

TABLE 9.—*Percentage of increase of total, white, and colored populations and proportion of white and colored populations to the total population, from 1730 to 1920, inclusive.*

Year.	Total population.		White population.			Colored population.								
						Total.			Free.			Slave.		
	Census count.	Percentage of increase.	Census count.	Percentage of increase.	Percentage to total population.	Census count.	Percentage of increase.	Percentage to total population.	Census count.	Percentage of increase.	Percentage to total population.	Census count.	Percentage of increase.	Percentage to total population.
1730	43	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1752	200	365.11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1775	5934	2867.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1776	6755	13.84	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1790	13503	99.90	11925	.....	88.31	1578	.....	11.69	323	.....	2.39	1255	.....	9.29
1800	26514	96.36	20900	75.26	78.83	5614	255.77	21.17	2771	757.89	10.45	2843	126.53	10.72
1810	46555	75.59	36212	73.26	77.78	10343	84.24	22.22	5671	104.66	12.18	4672	64.33	10.04
1820	62738	34.76	48055	32.70	76.60	14683	41.96	23.40	10326	82.08	16.46	4357	*6.74	6.94
1830	80625	28.51	61714	28.42	76.55	18911	28.80	23.46	14788	43.21	18.34	4123	*5.37	5.11
1840	102313	26.90	81147	31.49	79.31	21166	11.92	20.69	17967	21.50	17.56	3199	*22.41	3.13
1850	169054	65.23	140666	73.25	83.21	28388	34.12	16.79	25448	41.64	15.05	2940	*8.10	1.74
1860	212418	25.65	184520	31.18	86.87	27898	*1.73	13.13	25682	0.92	12.09	2212	*24.76	1.04
1870	267354	25.86	227794	23.45	85.20	39560	41.80	14.80	.....	.....	.....	.....	.....	.....
1880	332313	24.30	278584	22.30	83.83	53729	35.82	16.17	.....	.....	.....	.....	.....	.....
1890	434439	30.73	367143	31.79	84.51	67296	25.25	15.49	.....	.....	.....	.....	.....	.....
1900	508957	17.15	429218	16.91	84.33	79739	18.49	15.67	.....	.....	.....	.....	.....	.....
1910	558485	9.73	473387	10.29	84.76	85098	6.72	15.24	.....	.....	.....	.....	.....	.....
1920	733826	31.40	625074	32.05	85.18	108752	27.80	14.82	.....	.....	.....	.....	.....	.....

* Decrease.

consequence, have exercised imporant influences upon the morbidity and mortality rates, it is necessary to consider them in some detail. The essential data concerning the rate of growth and the proportion of whites and negroes to the total population are presented in table 9 compiled from the figures of Quinan, from 1730 to 1776, and from figures obtained from the reports or from the office of the Bureau of the Census, from 1790 to 1920. At the date of the first census (1790), Baltimore was among the five cities of the country with over 8,000 population, the others being Philadelphia and suburbs (42,444), New York (33,131), Boston (18,038), and Charleston (16,359).

RATE OF POPULATION INCREASE.

The history of the growth of population in Baltimore is epitomized in table 9. In regard to the whole population, it is evident that immigration

TABLE 10.—*The populations specific for certain age-groups, the percentages of increase of the latter over those of the preceding decennium; and the percentages of these age distributions of the respective total populations, for the census years, 1830 to 1920 inclusive.**

Age periods.	1830		1840			1850			1860			1870		
	Population.	Percent. of total population.	Population.	Percent. of increase.	Percent. of total population.	Population.	Percent. of increase.	Percent. of total population.	Population.	Percent. of increase.	Percent. of total population.	Population.	Percent. of increase.	Percent. of total population.
Under 1 year	.....	....	.....	....	....	6127	....	3.6	6522	6.4	3.1	7545	15.7	2.8
Between 1 and 2 years	.....	....	.....	....	....	18427	....	10.9	23901	29.7	11.3	27024	13.1	10.1
2 to 4 years														
0 to 4 years	11366	14.1	15227	34.0	14.9	24554	61.3	14.5	30423	23.9	14.3	34569	13.6	12.9
5 to 9 years	9447	11.7	11533	22.1	11.3	20068	74.0	11.9	25686	28.0	12.1	30653	19.3	11.5
0 to 9 years	20813	25.8	26760	28.6	26.2	44622	66.7	26.4	56109	25.7	26.4	65222	16.2	24.4
10 to 19 years	19178	23.8	22143	15.5	21.6	36592	65.3	21.6	43852	19.8	20.6	54399	24.1	20.3
0 to 19 years	39991	49.6	48903	22.3	47.8	81214	66.1	48.0	99961	23.1	47.0	119621	19.7	44.7
20 to 29 years	17093	21.2	22540	31.9	22.0	34354	52.4	20.3	40529	18.0	19.1	52227	28.9	19.5
0 to 29 years	57084	70.8	71443	25.2	69.8	115568	61.8	68.3	140490	21.6	66.1	171848	22.3	64.3
30 to 39 years	10888	13.5	14902	36.9	14.6	24561	64.8	14.5	31878	29.8	15.0	39347	23.4	14.7
0 to 39 years	67972	84.3	86345	27.0	84.4	140129	62.3	82.8	172368	23.0	81.1	211195	22.5	79.0
40 to 49 years	6274	7.8	7962	26.9	7.8	14509	82.2	8.6	20675	42.5	9.7	27213	31.6	10.2
0 to 49 years	74246	92.1	94307	27.0	92.2	154638	64.0	91.4	193043	24.8	90.8	238408	23.5	89.1
50 to 59 years	3509	4.4	4440	26.5	4.3	8102	82.5	4.8	11278	39.2	5.3	16432	45.7	6.1
0 to 59 years	77755	96.5	98747	27.0	96.5	162740	64.8	96.2	204321	25.6	96.1	254840	24.7	95.3
60 to 69 years	1744	2.2	2278	30.6	2.2	4118	80.8	2.4	5436	32.0	2.6	8341	53.4	3.1
0 to 69 years	79499	98.7	101025	27.1	98.7	166858	65.2	98.6	209757	25.7	98.7	263181	25.5	98.4
70 to 79 years	727	0.9	855	17.6	0.8	1643	92.2	1.0	2036	23.9	1.0	3258	60.0	1.2
70 years and over	1121	1.4	1288	14.9	1.2	2227	72.9	1.3	2660	19.4	1.3	4173	56.9	1.6
80 years and over	394	0.5	433	9.9	0.4	584	34.9	0.3	624	6.8	0.3	915	46.6	0.3
Total	80620	....	102313	26.9	....	169085	65 3	....	212417	25.6	....	267354	25.9	....

* The figures for the age-groupings of the populations for the years 1830, 1840, and 1870 are those obtained by graduations by Dr. Lowell J. Reed.

TABLE 10.—*The populations specific for certain age-groups, percentage of increase, etc.*†—Continued.

Age periods.	1880			1890			1900			1910			1920			Per cent of change in ratios of population distributed by age to total population 1850 to 1920.	
	Population.	Percent. of increase.	Percent. of total population.	Population.	Percent. of increase.	Percent. of total population.	Population.	Percent. of increase.	Percent. of total population.	Population.	Percent. of increase.	Percent. of total population.	Population.	Percent. of increase.	Percent. of total population.	Decl.	Incr.
Under 1 year..	8554	13.4	2.6	9567	11.8	2.2	10844	13.3	2.1	10239	*5.6	1.8	14852	45.1	2.0	44	....
Betw. 1 and 2..	} 29790	10.2	9.0	36514	22.6	8.4	{ 9376	} 8.7	{ 1.8	9612	2.5	1.7	}54504	30.6	7.4	32	....
2 to 4 years..							{ 30297		{ 6.0	32135	6.1	5.8				....	....
0 to 4 years..	38344	10.9	11.5	46081	20.2	10.6	50517	9.6	10.0	51986	2.9	9.3	69356	33.4	9.5	34	....
5 to 9 years..	36017	17.5	10.9	45422	26.1	10.5	51097	12.5	10.0	49617	*2.9	8.9	64492	30.0	8.8	26	....
0 to 9 years..	74361	14.0	22.4	91503	23.1	21.1	101614	11.0	20.0	101603	*0.01	18.2	133848	31.7	18.2	31	....
10 to 19 years..	66629	22.5	20.1	85169	27.8	19.6	98615	15.8	19.4	102760	4.2	18.4	123730	20.4	16.9	21	....
0 to 19 years..	140990	17.9	42.5	176672	25.3	40.7	200229	13.3	39.4	204363	2.1	36.6	257578	26.0	35.1	27	....
20 to 29 years..	[66429	27.2	20.0	87804	32.2	20.2	101326	15.4	20.0	113024	11.5	20.3	144897	28.2	19.7	3	....
0 to 29 years..	207419	20.7	62.5	264476	27.5	60.9	301555	14.0	59.4	317387	5.3	56.9	402475	26.8	54.8	18	....
30 to 39 years..	47944	21.8	14.4	[65353]	36.3	15.1	79797	22.1	15.7	88767	11.2	15.9	122393	37.9	16.7	....	15
0 to 39 years..	255363	20.9	76.9	329829	29.2	76.0	381352	15.6	75.1	406154	6.5	72.8	524868	29.2	71.5	14	....
40 to 49 years..	35304	29.7	10.6	46770	32.5	10.8	58091	24.2	11.4	68590	18.1	12.3	92342	34.6	12.6	....	47
0 to 49 years..	290667	21.9	87.5	376599	29.6	86.8	439443	16.7	86.5	474744	8.0	85.1	617210	30.0	84.1	8	....
50 to 59 years..	23204	41.2	7.0	30396	31.0	7.0	36221	19.2	7.1	45117	24.6	8.1	62563	38.7	8.5	....	77
0 to 59 years..	313871	23.2	94.5	[406995]	29.7	93.8	475664	16.9	93.6	519861	9.3	93.2	679773	30.7	92.6	4	....
60 to 69 years..	12230	46.6	3.7	16848	37.8	3.9	20722	23.0	4.1	24805	19.7	4.4	36008	45.2	4.9	....	104
0 to 69 years..	326101	23.9	98.2	423843	30.0	97.7	496386	17.1	97.7	544666	9.7	97.6	715781	31.4	97.5	1	....
70 to 79 years..	4915	50.9	1.5	6727	36.9	1.6	8983	33.5	1.8	10453	16.4	1.9	14414	37.9	2.0	....	100
70 and over....	6212	48.9	1.9	9170	56.3	2.3	11151	14.8	2.2	13124	17.7	2.4	17894	36.3	2.5	....	90
80 and over....	1297	41.7	0.4	2983	130.0	0.7	2168	*27.3	0.4	2671	23.2	0.5	3480	30.3	0.5	....	67
Total	332313	24.3	....	433553	30.5	....	507537	17.1	....	557790	9.9	....	733675	31.5	....	....	....

* Percentage of decrease.

† The population figures in brackets for 1880 and 1890 represent graduations from the 5-year age-groupings of the Bureau of the Census for those years.

played a predominant rôle in the rate of increase, which, until 1890, far exceeded any rate possible by the natural means of excess of births over deaths. With an average annual rate of increase of over 16 per cent between 1730 and 1752, from the latter date until 1810, the rate of growth was that of a boom town—124 per cent annually from 1752 to 1775, and 9 per cent from 1775 to 1810. During the three decades 1810 to 1840, the average annual rate of increase was less than 3 per cent. There was a sudden jump to 6.5 per cent between 1840 and 1850, followed by a descent to an average annual rate of about 2.7 per cent for the 40 years between 1850 and 1890. During the last three decades the rate of increase was much reduced. The sharp rise in the rate of increase between 1880 and 1890 was associated with a considerable annexation in 1888, the only extension of the city's boundaries since 1816. It is probable that but for the influx of population in 1916–1918, due to conditions arising out of the Great War and the third great annexation in 1919, the annual rate of increase between 1900 and 1920 would have followed the general average of less than 1 per cent, which obtained in the previous decade, when for the first time in the history of Baltimore the rate of growth approached the natural rate of increase, or that regulated by the increase of births over deaths.

In table 10 is given the numerical distribution by certain age-groups for the total population for the census years 1830 to 1920, inclusive, together with the percentage borne by each age-group to the respective totals, the percentage of increase in each age-group from one decennium to the next, and the percentage of changes in the ratios, whether decline or increase, of population distributed by age to total population from 1850 to 1920. For the years 1850, 1860, 1900, 1910, and 1920 the figures for the various age-groupings are copied directly from the publications of the Bureau of the Census. For the other years it has been necessary to resort to graduation to obtain comparable figures for certain of the age-groupings. For 1830 and 1840 it was necessary to graduate the figures for the negro moiety of the population, and for 1880 and 1890 the census figures given for 5-year groupings were graduated to 10-year groupings. The figures for the age-groupings for 1870 were graduated throughout. These data may be regarded as reasonably correct for measurement of changes in these age-groupings and for the calculation of morbidity and mortality rates specific for age. Of particular importance are the data concerning the proportional distribution of the population below the various decades of life for the decennial or census years. Attention is directed particularly to the ratios of decrease and of increase in the different age-groups between 1850 and 1920 which are given in the last two columns of the table. These changes, while considerable when measured over this span of 70 years, were in the main gradual from one decennium to the next. Their important bearing upon the interpretation of crude mortality rates from all causes and upon morbidity and mortality rates from specific diseases and groups of diseases is obvious.

Populations specific for the same age-groupings by color and sex for 1910 and 1920 are given in table 11.

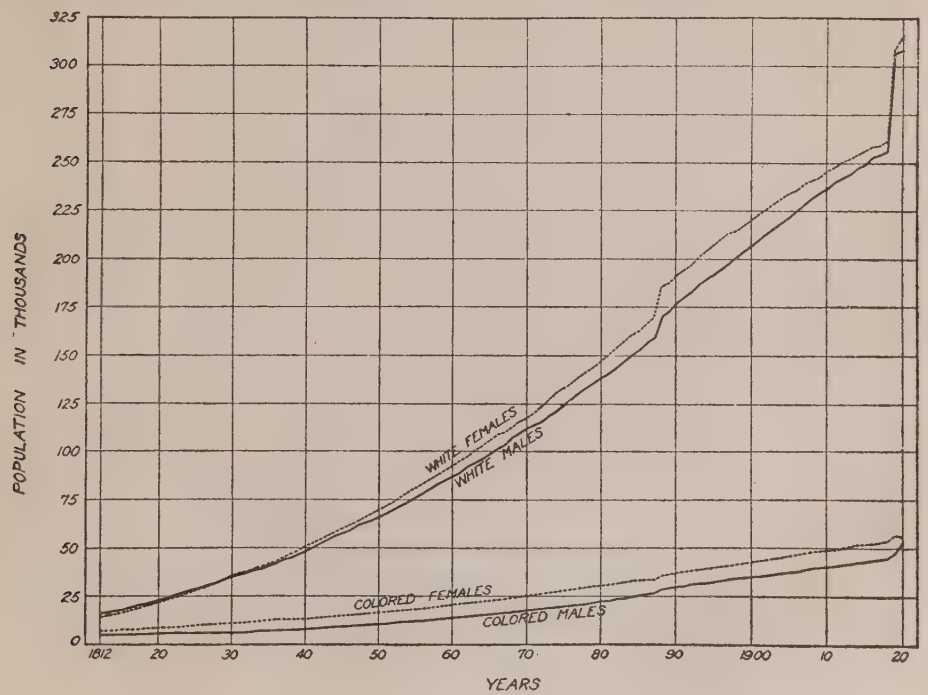
In table 12, graph 1, are presented the figures for the population at all ages, for total population, and for color and sex which will be used in this work for the calculation of all natality, morbidity, and mortality rates except those specific for age. These populations were estimated by Dr. John Rice Miner by

fitting curves by the method of least squares to the populations of Baltimore at the several censuses. In order to allow for the discontinuity due to the annexation of 1888, the following procedure was adopted: Before 1888 the population

TABLE 11.—*Populations specific for certain age groupings by color and sex for 1910 and 1920.*

Age period.	1910						1920					
	White.			Colored.			White.			Colored.		
	Total.	Male.	Fem.	Total.	Male.	Fem.	Total.	Male.	Fem.	Total.	Male.	Fem.
Under 1 year.....	8891	4489	4402	1348	685	663	12884	6600	6284	1968	957	1011
Between 1 and 2 years	8485	4384	4101	1127	557	570	48097	24145	23952	6409	3113	3294
2 to 4 years.....	27980	14062	13918	4155	2012	2143						
5 to 9 years.....	43199	21679	21520	6418	3060	3358	56423	28582	27841	8069	3861	4208
0 to 9 years.....	88555	44614	43941	13048	6314	6734	117404	59327	58077	16444	7931	8513
10 to 19 years.....	88989	42838	46151	13771	5850	7921	107776	52818	54958	15954	7069	8885
20 to 29 years.....	92404	44456	47948	2060	9044	11576	19068	58780	60288	25829	12187	13642
30 to 39 years.....	72960	35574	37386	15807	7650	8157	100573	50434	50139	21820	11053	10767
40 to 49 years.....	57195	27564	29631	11395	5655	5740	76767	38202	38565	15575	8285	7290
50 to 59 years.....	39054	18883	20171	6063	2960	3103	54705	26684	28021	7858	4245	3613
60 to 69 years.....	21917	9883	12034	2888	1320	1568	32543	15306	17237	3465	1713	1752
70 to 79 years.....	9457	3938	5519	996	403	593	13058	5597	7461	1356	605	751
80 years and over....	2375	858	1517	296	93	203	3126	1123	2003	354	134	220
Total	472906	228608	244298	84884	39289	45595	625020	308271	316749	108655	53222	55433

figures were taken from a logarithmic curve which fitted that portion of the census figures most closely, whereas the figures for the period since 1888 were taken from an autocatalytic curve (44). In this way the sudden increase in the population at the annexation was satisfactorily represented.



GRAPH 1 (from table 12). Estimated annual populations, in thousands, for males and females, white and colored, for Baltimore from 1812 to 1920, inclusive.

TABLE 12.—*Estimated population of Baltimore City, as of July 1 of each year, from 1812 to 1920, inclusive.*

Year.	Total.			White.			Colored.		
	Total.	Male.	Fem.	Total.	Male.	Fem.	Total.	Male.	Fem.
1812	40937	20388	20549	30076	15997	14079	10861	4391	6470
1813	42799	21224	21575	31649	16748	14901	11150	4476	6674
1814	44731	22092	22639	33288	17529	15759	11443	4563	6880
1815	46734	22992	23742	35000	18343	16657	11734	4649	7085
1816	48813	23927	24886	36780	19189	17591	12033	4738	7295
1817	50962	24897	26065	38629	20068	18561	12333	4829	7504
1818	53189	25902	27287	40549	20979	19570	12640	4923	7717
1819	55486	26940	28546	42535	21921	20614	12951	5019	7932
1820	57859	28014	29845	44590	22895	21695	13269	5119	8150
1821	60305	29123	31182	46713	23901	22812	13592	5222	8370
1822	62825	30266	32559	48902	24938	23964	13923	5328	8595
1823	65418	31446	33972	51158	26007	25151	14260	5439	8821
1824	68088	32662	35426	53483	27109	26374	14605	5553	9052
1825	70834	33915	36919	55875	28242	27633	14959	5673	9286
1826	73651	35202	38449	58332	29406	28926	15319	5796	9523
1827	76544	36525	40019	60854	30600	30254	15690	5925	9765
1828	79513	37887	41626	63445	31829	31616	16068	6058	10010
1829	82555	39284	43271	66099	33087	33012	16456	6197	10259
1830	85674	40716	44958	68821	34377	34444	16853	6339	10514
1831	88867	42187	46680	71607	35698	35909	17260	6489	10771
1832	92136	43694	48442	74458	37050	37408	17678	6644	11034
1833	95479	45238	50241	77375	38434	38941	18104	6804	11300
1834	98901	46820	52081	80357	39849	40508	18544	6971	11573
1835	102395	48439	53956	83403	41295	42108	18992	7144	11848
1836	105966	50094	55872	86515	42772	43743	19451	7322	12129
1837	109612	51788	57824	89691	44281	45410	19921	7507	12414
1838	113335	53519	59816	92932	45821	47111	20403	7698	12705
1839	117132	55286	61846	96237	47391	48846	20895	7895	13000
1840	121008	57093	63915	99608	48994	50614	21400	8099	13301
1841	124956	58936	66020	103041	50627	52414	21915	8309	13606
1842	128983	60817	68166	106539	52291	54248	22444	8526	13918
1843	133084	62737	70347	110102	53987	56115	22982	8750	14232
1844	137264	64693	72571	113729	55713	58016	23535	8980	14555
1845	141518	66689	74829	117420	57471	59949	24098	9218	14880
1846	145848	68720	77128	121174	59259	61915	24674	9461	15213
1847	150252	70790	79462	124991	61078	63913	25261	9712	15549
1848	154737	72900	81837	128874	62929	65945	25863	9971	15892
1849	159294	75046	84248	132820	64811	68009	26474	10235	16239
1850	163930	77231	86699	136829	66723	70106	27101	10508	16593
1851	168640	79454	89186	140902	68667	72235	27738	10787	16951
1852	173427	81715	91712	145037	70641	74396	28390	11074	17316
1853	178293	84016	94277	149239	72648	76591	29054	11368	17686
1854	183233	86353	96880	153502	74684	78818	29371	11669	18062
1855	188251	88730	99521	157829	76751	81078	30422	11979	18443
1856	193344	91145	102199	162219	78850	83369	31125	12295	18830
1857	198514	93598	104916	166672	80979	85693	31842	12619	19223
1858	203761	96089	107672	171188	83138	88050	32573	12951	19622
1859	209083	98620	110463	175768	85330	90438	33315	13290	20025
1860	214484	101188	113296	180411	87552	92859	34073	13636	20437
1861	219957	103794	116163	185115	89804	95311	34842	13990	20852
1862	225511	106439	119072	189884	92087	97797	35627	14352	21275
1863	231140	109124	122016	194716	94402	100314	36424	14722	21702
1864	236845	111846	124999	199611	96747	102864	37234	15099	22135
1865	242629	114608	128021	204570	99124	105446	38059	15484	22575
1866	248487	117407	131080	209589	101530	108059	38898	15877	23021

TABLE 12.—*Estimated population of Baltimore City as of July 1 of each year, from 1812 to 1920, inclusive*—Continued.

Year.	Total.			White.			Colored.		
	Total.	Male.	Fem.	Total.	Male.	Fem.	Total.	Male.	Fem.
1867	254422	120246	134176	214672	103968	110704	39750	16278	23472
1868	260435	123122	137313	219820	106437	113383	40615	16685	23930
1869	266523	126039	140484	225029	108937	116092	41494	17102	24392
1870	272690	128993	143697	230301	111467	118834	42389	17526	24863
1871	278932	131987	146945	235636	114028	121608	43296	17959	25337
1872	285251	135018	150233	241034	116620	124414	44217	18398	25819
1873	291646	138089	153557	246493	119242	127251	45153	18847	26306
1874	298121	141200	156921	252016	121896	130120	46105	19304	26801
1875	304670	144348	160322	257603	124581	133022	47067	19767	27300
1876	311297	147536	163761	263251	127296	135955	48046	20240	27806
1877	318000	150762	167238	268962	130042	138920	49038	20720	28318
1878	324783	154028	170755	274737	132819	141918	50046	21209	28837
1879	331639	157333	174306	280573	135627	144946	51066	21706	29360
1880	338573	160675	177898	286472	138465	148007	52101	22210	29891
1881	345584	164057	181527	292434	141334	151100	53150	22723	30427
1882	352674	167479	185195	298459	144235	154224	54215	23244	30971
1883	359838	170938	188900	304545	147165	157380	55293	23773	31520
1884	367079	174437	192642	310693	150126	160567	56386	24311	32075
1885	374396	177974	196422	316904	153118	163786	57492	24856	32636
1886	381793	181551	200242	323178	156141	167037	58615	25410	33205
1887	389265	185167	204098	329515	159195	170320	59750	25972	33778
1888	419572	198102	221470	355859	170192	185667	63713	27910	35803
1889	427078	201823	225255	362225	173370	188855	64853	28453	36400
1890	434560	205547	229013	368560	176547	192013	66000	29000	37000
1891	442011	209271	232740	374858	179719	195139	67153	29552	37601
1892	449429	212994	236435	381116	182886	198230	68313	30108	38205
1893	456808	216714	240094	387329	186045	201284	69479	30669	38810
1894	464092	220426	243666	393492	189193	204299	70600	31233	39367
1895	471426	224129	247297	399602	192328	207274	71824	31801	40023
1896	478657	227822	250835	405654	195449	210205	73003	32373	40630
1897	485832	231501	254331	411646	198554	213092	74186	32947	41239
1898	492945	235164	257781	417573	201639	215934	75372	33525	41847
1899	500141	238810	261331	423580	204705	218975	76561	34105	42456
1900	506970	242435	264535	429218	207747	221471	77752	34688	43064
1901	513875	246038	267832	434930	210765	224165	78945	35273	43672
1902	520706	249619	271087	440566	213758	226808	80140	35861	44279
1903	527456	253172	274284	446121	216722	229399	81335	36450	44885
1904	534122	256697	277425	451593	219657	231936	82529	37040	45489
1905	540705	260193	280512	456981	222561	234420	83724	37632	46092
1906	547212	263667	283545	462284	225433	236851	84928	38234	46694
1907	553609	267090	286519	467497	228271	239226	86112	38819	47293
1908	559924	270487	289437	472620	231073	241547	87304	39414	47890
1909	566145	273848	292297	477653	233840	243813	88492	40008	48484
1910	572269	277170	295099	482591	236568	246023	89678	40602	49076
1911	578297	280455	297842	487436	239258	248178	90861	41197	49664
1912	584227	283698	300529	492187	241908	250279	92040	41790	50250
1913	590056	286900	303156	496841	244517	252324	93215	42383	50832
1914	595785	290060	305725	501400	247085	254315	94385	42975	51410
1915	601413	293176	308237	505863	249611	256252	95550	43565	51985
1916	606937	296247	310690	510228	252093	258135	96709	44154	52555
1917	612360	299273	313087	514497	254532	259965	97863	44741	53122
1918	617680	302254	315426	518671	256928	261743	99009	45326	53683
1919	721192	355107	366085	616912	307237	309675	104280	47870	56410
1920	733826	361611	372215	625074	308340	316734	108752	53271	55481

RACIAL COMPOSITION OF THE POPULATION—WHITE.

As in the colony of Maryland, so in early Baltimore, the bulk of the white population was of English, Welsh, or Scotch descent. In the earliest records of Baltimore Town, English surnames were predominant in number, with a sprinkling of Scotch and Irish. Many of those bearing Scotch names are known to have immigrated from the north of Ireland and have often been erroneously classed as of Irish stock. According to the United States census of 1790, the 208,604 white inhabitants of Maryland, classified according to blood or nationality strain, as determined by their surnames, were: English 84 per cent, Scotch 6.5 per cent, Irish 2.4 per cent, German 5.9 per cent, French 0.7 per cent, Hebrew 0.3 per cent, Dutch 0.1 per cent, all other 0.1 per cent. While it is probable that the population of Baltimore was at that time distributed racially in very much the same proportions, it is likely that the proportions for Germans and for Dutch would be too high and those for French and Jews too low, for it can safely be assumed that most of the people with German and Dutch names in Maryland had settled in the counties bordering on the Pennsylvania line, that the considerable French colony would have attracted many of their associates to the town, and that nearly all of the Jews would have settled in the largest trading town of the State. As would be expected, the proportion of people of British extraction—English, Welsh, and Scotch—was largely predominant, and that for this and for other reasons they put their stamp indelibly upon the life and characteristics of the town and city.

Owing to the incompleteness and the vagaries of the reports on population issued by the Bureau of the Census, it is impossible to determine with any satisfactory degree of accuracy the numbers and proportions of any of the various stocks of the white race in Baltimore for the different census years since 1790. No information at all on this point appears before 1860. However, from figures giving the number of foreign-born from various countries for 1860, 1870, and 1880, and for the number of foreign-born of various countries and of native-born of such parents (the immigrant and first generation in Baltimore) for 1890, 1900, and 1910, it has been possible to make estimates of the actual numbers of representatives of certain prominent race stocks in the population as of 1910. Since in the first three of these decennia no mention is made of any but the first generation—the immigrant, and in the last three decennia all except the first two generations—the immigrant and the first generation born in this country—are ignored in the census reports, the resulting estimates may be regarded as only rough approximations to the truth. The results are further complicated by the fact that, for the most part, the immigrants were classified geographically, and considerable difficulty has attended the extraction of Jews from Germany and Austria from ethnological Germans, and Poles and Bohemians from Austro-Germans, who in turn must be classed with Germans. As British have been classed all immigrants from British colonies and dominions (except French Canadians), as well as those from England, Wales, and Scotland. To save space, the essential facts selected from an elaborate compilation of data have been condensed into table 13, showing the numbers and percentages contributed by each important race-stock in the population as of 1910. On the basis of these two estimates and with the aid of pertinent facts supplied by local chroniclers, the history of the growth of each of the important white race-stocks will be traced in.

The British element has received additions from three sources by migrants; directly from England, Wales, Scotland, and Ireland, especially numerous just before and after the War of the Revolution and after the Napoleonic Wars; from British colonies, particularly Canada and the West Indies; and from Maryland and other colonies and States as Americans of British descent. Of these groups, the last is the most important. Members of this group were derived especially from New England, New York, New Jersey, Delaware, Pennsylvania, Virginia, and North Carolina, and, to a less degree, in later years, from western States and States farther south. These people, representing the best development of the British stock in this country, and imbued with the spirit of adventure, were by far the most important additions gained by migration. The influx beginning just before 1776 was particularly strong until about 1840, and, while no definite figures can be given, it seems certain that the larger proportion of these people were contributed by New England, Maryland, and Virginia. After the Civil War there was a particularly heavy migration of people from Virginia and North Carolina. Fusing readily with the local population, the migrants from all these States assumed leading rôles in thought, education, commerce, finance, and the professions. It is probable that from 1815 until 1860 there was a considerable migration to Baltimore of Britons from the mother country and from the colonies. The census figures from 1860 show a comparatively small but steadily increasing immigration from these sources, the British-born numbering 2,925 in 1860, 3,141 in 1870, 3,448 in 1880, 3,637 in 1890, 4,182 in 1900, and 4,087 in 1910. This stock, always the most numerous single stock forming the bulk of the white population before 1830, probably remained in the majority until after the Civil War. In 1910, estimated at 160,000, it formed 33 per cent. In point of time, due to the migrations of Acadians in 1755 and of the French from San Domingo, people of French extraction composed the most numerous non-British element. The first French immigrants, whose exact number is unknown, were sufficiently numerous to have the name "French Town" given to the quarter in which they were settled, and must have formed, for a time at least, one-fourth of the

TABLE 13.—*Population.*

Stock.	Population.	Percentage of population of specified race stock to total white population.
British	160000	33.70
German	132000	27.80
Irish	62500	13.16
Jewish	50000	10.53
Polish	22000	4.63
Bohemian	10000	2.11
Italian	10000	2.11
French	8000	1.68
Unimportant	20319	4.28
Total white population	474819	100.00

population of Baltimore Town. They were notably industrious and frugal, and many of them turned to ship-building. The second migration, comprising 3,000, and including an unknown number of negro slaves, left San Domingo in consequence of the revolution and reached Baltimore in 1793. Many of them were people of property, education, and talent, and soon took a leading part in the business, professional, social, and religious life of the community. Some of the most distinguished families of present-day Baltimore trace their ancestry to these immigrants. In 1794 probably 20 per cent of the white population was of French blood. Immigration of the French since 1793 has been small and intermittent, and it is unlikely that there were more than 8,000 people of French blood in Baltimore in 1910.

The relation of the Irish to Baltimore is of peculiar interest and importance. While many, both Protestant and Catholic, came to the Maryland colony, at one period the migration of the latter was discouraged by a discriminatory tax. Though the land upon which Baltimore Town was laid out was purchased from the prominent land-owning Catholic Carroll family, members of which were early identified with the town, it does not appear that any considerable proportion of the early inhabitants were of this origin. The Catholic Irish, who really represent the distinctively Irish race, had become sufficiently numerous by the last of the eighteenth century to play an important part in the social, commercial, and professional life of the town, and their influence has continually grown. To what extent this portion of the population was recruited from the counties of Maryland, from other colonies or States, and by direct migration from Ireland it is not possible to state with exactness. Certain it is that after the peace of 1815, there began a steady stream of migration of Catholic Irish from Ireland to Baltimore, which, assuming large proportions in the third and fourth decades of the nineteenth century, reached its high point in the fifth decade, and, continuing at a slower rate until 1870, had practically died out in 1890. According to the census reports, there were recorded in Baltimore as born in Ireland 15,511 persons in 1860, 15,223 in 1870, 14,238 in 1880, 13,659 in 1890, 9,690 in 1900, and 6,806 in 1910. Of Irish birth and native-born of Irish parentage, there were 38,051 in 1890, 33,100 in 1900, and 27,465 in 1910. From these figures it would appear that in 1910 there were not far from 62,500 persons of Irish Catholic stock in Baltimore. The Protestant Irish, some bearing names suggestive of English origin but most of them evidently of Scotch extraction, have been included among the British. They have taken throughout the history of the city a leading part and have exercised an influence out of proportion to their number. The Stevenson brothers, Henry, the leading physician of his day, and John, the founder of Baltimore's commerce, arrived in 1745.

The Germans came to Baltimore early, the first arriving in 1752 from Lancaster, Pennsylvania. Dr. Charles Wiessenthal, the accomplished physician and Revolutionary patriot, came in 1755. The Germans were sufficiently numerous to establish a Lutheran Church in 1758 and in 1790 probably exceeded 800. The Germans, mostly from the Palatinate, of the early migration took a prominent part in the town and city and soon merged into the general population by both association and marriage. The later accessions came in greatest numbers from Prussia, Saxony, Wurttemburg, Hanover, and Austria. Bremen

enjoyed a large commerce with Baltimore by 1830, and during the third, fourth, fifth, sixth, and seventh decades of the nineteenth century there was a strong tide of German immigration to Baltimore. The peak of the German migration was some 10 or 15 years later than that of the Irish. The number of German-born in Baltimore was 32,608 in 1860, 35,491 in 1870, 34,337 in 1880, 40,480 in 1890, 34,564 in 1900, and 25,104 in 1910. The German-born and native-born of German parentage numbered 111,172 in 1890 and declined to 94,002 in 1910. All these figures, however, include German Jews. If 100,000 be taken as the approximate number of German-born and native children of true German stock in 1890, it is probable that in 1910 the whole number of representatives of this stock in Baltimore was not far from 132,000.

The early Jewish settlers in Baltimore probably came from Holland and England, for several Jewish families of distinction, belonging to the well-known group of "Spanish" Jews, prominent in the Netherlands since 1492 and later in England, settled in Baltimore at an early date. With this exception the Jewish immigrants to Baltimore, until about 1884, came almost entirely from the German states and bear typically German names. This immigration probably began after 1830 and practically ceased with 1870. The total Jewish population of Baltimore was estimated in 1880 as about 10,000 by Dr. Aaron Friedenwald, a distinguished physician and publicist of that race. With additions from other parts of this country and by natural increase, German Jews probably numbered 20,000 by 1910. A third immigration of Jews, resulting in a population which can be measured with a considerable degree of accuracy, began about 1884 from Russian Poland, in consequence of religious and social persecution. The foreign-born Polish Jews, numbering 179 in 1880, increased to 4,118 in 1890, 10,509 in 1900, and 15,585 in 1910, and the number of native-born of such parentage (first generation) increased from 1,435 in 1890 to 11,557 in 1910. Since in the latter year the combined figure for foreign-born and the first generation of descendants was 27,142, it is likely that 30,000 is a fair estimate of the total number of Polish Jews at that date. Therefore, the whole number of persons of Jewish stock in Baltimore in 1910 may be reckoned as 50,000.

A stream of emigrants from southern and southeastern Europe started about 1870. Weak at first, it had reached considerable proportions by 1910. In order of their arrival were the Bohemians, who in 1910 numbered 7,750 as foreign-born and as first-generation native-born, with a probable total of 10,000. The Italian migration, starting about 1870, first from northern but later almost entirely from southern Italy and Sicily and gradually increasing, resulted in the presence of 8,540 persons of foreign birth and natives of the first generation, with a probable total of 10,000 of this stock in 1910. In addition, small numbers of people of diverse stocks have come from Hungary, Greece, Bulgaria, Serbia, Roumania, and Turkey.

From the north of Europe a migration of Poles started about 1870, reached considerable size by 1900, and by 1910 there were 11,123 foreign-born and 10,476 native-born of the first generation, with a probable total of 22,000. In the last decade of the nineteenth and the first decade of the twentieth century a small number of Lithuanians, Letts, Russians, and Finns entered. From time to time there have come, within the last 50 years, a small number of persons

from Scandinavia, Belgium, Holland, Switzerland, Spain, Portugal, and other countries of Europe and from South America. The total of these races, together with immigrants from southern Europe, other than Italians and Bohemians, represent the group of numerically unimportant stocks in the table, estimated to number 20,319 in 1910.

The percentages of actual foreign-born whites to the total whites for the decennia from 1860 to 1910, inclusive, were 28.35, 24.70, 20.10, 18.60, 15.97, and 16.24, respectively.

From the foregoing it is especially to be noted that the basic race stock of Baltimore, those of British ancestry descended largely from English, Welsh, and Scotch who settled in the colonies or in the States of the United States before 1820, has been the predominant stock numerically. Until 1870 it must have comprised considerably over 50 per cent of the white population.

Up until 1880 the white population consisted almost exclusively of people of British, German, Irish, French, and Jewish stocks, with the first three very largely in excess, who had been in association through many years. The first-named four of these, though divided to some degree by relatively minor differences, had long since become fused into a compact citizenship in business and social life and even in intermarriage. Since 1880, new and important racial factors have been added by the arrival of Poles, Polish Jews, Bohemians, Italians, Lithuanians, and others, who have preserved the habits, customs, languages, and racial prejudices peculiar to themselves and which have tended to cut them off from each other and from the rest of the population. To a very large degree they live in colonies and work and worship in racial groups.

POPULATION GROWTH—COLORED.

Since at no time in the history of Baltimore have Indians and Mongolians been numerous, the term *colored* has meant persons of African negro blood, either pure or in various degrees of admixture with white blood; hence, for convenience, here as elsewhere in this work, the word *negro* will be used for *colored*. There exist no reliable figures for the negro population of Baltimore before the census of 1790. The rate of increase in the decade 1790–1800 was high, averaging over 25 per cent per annum, continuing at a relatively high level for the next decade, and descending irregularly until there was an actual loss in population in the sixth decade. There was a decided rise between 1860 and 1870, then the rate of increase fell consistently during the following four decades. Between 1910 and 1920 there was a marked increase. Notwithstanding these wide fluctuations in the rate of increase, between 1800 and 1840 the percentage of negroes to the total population varied within narrow limits, the average being about 22 per cent; after dropping during the sixth decade of the nineteenth century to 13 per cent, it gradually rose, so that from 1870 to 1920 it stood close to 15.5 per cent. Since the birth-rate of the negro in Baltimore has probably never approached his death-rate, for any length of time at least, it is evident that his growth in population has been determined almost, if not entirely, by immigration. This immigration has doubtless been governed by demands for laborers and domestic servants. Whereas the number and percentage of slave negroes increased from 1790 to 1810, after the latter date there was a gradual decrease, until by 1860 they numbered less than in 1800. In

1860 they formed only 1 per cent of the population and 8 per cent of the negroes. It is evident that conditions in Baltimore were not favorable to negro slavery. On the other hand, the city has had strong attractions for negro immigrants who have come particularly from the States of Maryland, Virginia, North Carolina, and Georgia.

NATALITY.

LIVING BIRTHS.

No record of living births was kept until 1875, when by law it became the duty of physicians and midwives to report them. Before 1912 the health department made no consistent efforts to enforce this law, and it was not until 1915 that Baltimore was included among the birth-registration cities. Data for the live births recorded annually between 1875 and 1920 and their ratios to the total population and to whites and negroes separately are given in table 14. It is evident from these figures that birth registration was very defective until 1915. In the whole population the recorded live birth-rate exceeded the death-rate, in but 12 of the 46 years between 1875 and 1920, and in only 7 of the 40 years previous to 1914. In the 37 years between 1884 and 1920, the official birth-rate surpassed the death-rate in whites in only 19 years and in negroes in only 2 years. The death-rate exceeded the recorded birth-rate among whites in each year between 1898 and 1911, inclusive. Since 1912 the birth-rate has been well above the death-rate in this section of the population. Among negroes this discrepancy between birth and death rates obtained in every year for which birth records exist, except in 1919 and 1920, when the death-rates were unusually low and the birth-rates were the highest recorded. Since 1883 in only one year, 1918, can this excess of deaths over births so frequently recorded be attributed to a severe epidemic. For the six-year period 1915–1920, during which it may be held that live births were reported with approximate completeness, the average annual birth and death rates per 1,000 living population were for whites, 24.43 and 16.50 and for negroes 24.62 and 28.43, respectively. When 1918, the influenza year, with its exceptionally heavy mortality, is left out of consideration, the respective rates were 24.32 and 15.05, and 24.87 and 26.60. Therefore, in recent years, on an average for each 1,000 inhabitants among whites the excess in births over deaths was 9, while among negroes there was an excess of 1.7 in deaths over births, or, in other words annually, by this means, the whites increased by almost 1 per cent and the negroes decreased by 0.17 per cent.

The vital index, i. e., the percentage of births to deaths, proposed by Pearl (45) as a delicate test in the study of population growth, may be used conveniently here to measure the accuracy of reporting of living births. The vital indices for the total population for whites and for negroes are presented in table 14. It will be observed that for the population as a whole the vital index exceeded 100 in only 7 years between 1875 and 1914, and in only 4 years before 1912. During the whole period from 1895 to 1912, when the recorded birth-rate was always below 20 per 1,000, in but 3 years did the vital index exceed 90. Among whites, while between 1884 and 1894 the birth-rate was always between 20 and 22 per 1,000, the vital index was, with the exception of

TABLE 14.—*Number of recorded births, living and still, percentage of still to total births, and rates, per 100,000 living inhabitants, and vital indices for the whole population and for white and colored, from 1875 to 1920, inclusive.*

Year.	Total. births.	Still births.	Per cent of still births to total births.	Living births.								
				Total.			White.			Colored.		
				No.	Rate.	Vital index.	No.	Rate.	Vital index.	No.	Rate.	Vital index.
1875 ..	8735	560	6.4	8175	2683	112.6	.....	.....	....	.....	.....	....
1876 ..	7838	588	7.5	7250	2329	96.7	.....	.....	....	.....	.....	....
1877 ..	7146	538	7.5	6608	2078	83.5	.....	.....	....	.....	.....	....
1878 ..	6715	655	9.8	6060	1866	90.0	.....	.....	....	.....	.....	....
1879 ..	8227	620	7.5	7607	2294	99.9	.....	.....	....	.....	.....	....
1880 ..	9462	636	6.7	8826	2607	109.7	.....	.....	....	.....	.....	....
1881 ..	9158	651	7.1	8507	2462	96.5	.....	.....	....	.....	.....	....
1882 ..	8436	677	8.0	7759	2200	86.9	.....	.....	....	.....	.....	....
1883 ..	8605	701	8.1	7904	2197	84.3	.....	.....	....	.....	.....	....
1884 ..	8881	746	8.4	8025	2186	96.8	6889	2217	107.7	1136	2015	59.9
1885 ..	8390	650	7.7	7740	2067	94.9	6632	2093	104.9	1108	1927	60.6
1886 ..	8415	718	8.5	7694	2015	92.3	6481	2005	100.1	1213	2069	65.1
1887 ..	9726	699	7.2	9027	2319	107.8	7765	2356	121.7	1262	2112	63.4
1888 ..	9419	694	7.4	8725	2079	97.6	7500	2108	108.8	1225	1923	60.0
1889 ..	10149	784	7.7	9365	2193	107.6	8102	2237	118.8	1263	1947	67.0
1890 ..	10198	800	7.8	9398	2163	92.2	8226	2232	102.5	1172	1776	54.0
1891 ..	10150	811	8.0	9339	2113	92.7	8238	2198	105.1	1101	1640	49.3
1892 ..	10247	813	7.9	9434	2099	89.2	8087	2122	96.7	1347	1972	60.6
1893 ..	9905	770	7.8	9135	2000	95.6	7914	2043	107.4	1221	1757	55.9
1894 ..	10104	721	7.1	9383	2022	98.9	8030	2041	110.9	1353	1916	60.3
1895 ..	8725	666	7.6	8059	1709	78.2	7667	1919	97.2	1392	1938	57.6
1896 ..	9472	678	7.2	8794	1837	88.7	7495	1848	98.5	1299	1779	56.3
1897 ..	9506	706	7.4	8800	1811	94.3	7382	1793	103.1	1418	1911	65.5
1898 ..	9541	748	7.8	8793	1784	84.7	7227	1731	91.4	1566	2078	63.2
1899 ..	8739	701	8.0	8038	1607	79.2	6796	1604	87.5	1242	1622	52.0
1900 ..	9335	682	7.3	8653	1707	80.9	7242	1687	89.5	1411	1815	54.1
1901 ..	9467	672	7.1	8795	1712	83.9	7125	1638	90.7	1670	2115	63.7
1902 ..	9609	659	6.9	8950	1719	87.3	7193	1633	93.0	1757	2192	69.7
1903 ..	9361	741	7.9	8620	1634	85.0	7001	1569	91.4	1619	1991	65.2
1904 ..	9309	710	7.6	8599	1610	79.5	6863	1520	84.7	1736	2104	63.9
1905 ..	9765	814	8.3	8951	1655	83.7	7077	1549	89.1	1874	2238	68.0
1906 ..	9928	826	8.3	9102	1663	84.6	7300	1579	90.9	1802	2122	66.3
1907 ..	9555	794	8.3	7861	1583	78.3	7128	1525	85.1	1633	1896	58.1
1908 ..	9989	811	8.1	9178	1639	88.0	7564	1600	96.1	1614	1849	63.0
1909 ..	9613	817	8.5	8796	1554	84.8	7313	1531	93.9	1483	1676	57.4
1910 ..	10680	822	7.7	9858	1723	91.7	7941	1645	97.5	1917	2138	73.5
1911 ..	9995	712	7.1	9283	1605	89.2	7592	1558	97.8	1691	1861	63.9
1912 ..	12087	689	5.7	11398	1951	109.2	9387	1907	119.1	2011	2185	78.5
1913 ..	13451	909	6.8	12542	2126	123.3	10309	2075	131.3	2233	2396	96.3
1914 ..	13663	1026	7.5	12637	2121	119.8	10665	2127	134.8	1972	2089	74.8
1915 ..	14765	1131	7.7	13634	2267	136.3	11460	2265	152.3	2174	2275	87.8
1916 ..	16320	1235	7.6	15085	2485	140.7	12662	2482	158.6	2423	2505	88.6
1917 ..	16217	1267	7.8	14950	2441	131.6	12582	2445	150.5	2368	2420	78.9
1918 ..	16492	1200	7.3	15292	2476	95.4	12975	2502	105.4	2317	2340	62.3
1919 ..	18958	1327	7.0	17631	2445	154.2	14908	2417	167.7	2723	2611	107.0
1920 ..	20185	1398	6.9	18787	2560	165.4	15934	2549	181.5	2853	2623	110.7

a single year, invariably above 100, from 1895 to 1912, with birth-rates consistently below 20, the vital index was under par in every year except 2. With the increase in the recorded birth-rate after 1915, the vital index for whites rose to levels characteristic for a population growing rapidly by excess of births over deaths. Between 1884 and 1911 the vital index for negroes was commonly below 60 and never exceeded 70, but in one year. It is true that for the negro, with the high death-rate that existed during all these years, a birth-rate of well over 30 per 1,000 population would have been necessary for a vital index of 100. It was not until the considerable fall in the death-rate, together with the rise in the recorded birth-rate, that the vital index for this race rose above 100. The conclusion is inevitable that until 1916 the reporting of live births was far from complete in both races, and that the losses in population presaged by the official figures were apparent and not real.

It is not possible from the data at hand to estimate with any accuracy the probable birth-rates for the white and negro populations previous to 1916. It is probable, however, that since 1812, the white live birth-rate has rarely if ever fallen below 20 and has often been higher than 30 per 1,000 inhabitants. It is reasonably certain that during this period, except in connection with unusually severe epidemics, there has been for this race a comfortable annual surplus of live births over deaths, which would have insured a steady but moderate increase of population independent of immigration. It is likely that on the whole the live birth-rate has been higher in the negro than in the white race. With his much higher death-rates, however, only in exceptional years could the births have exceeded the deaths in this race. It follows, then, that by and large the white population has undergone a healthy natural increase and that the negro population has not been self-sustaining in the same sense, and its actual increase has been due entirely to immigration.

Data regarding the relative frequency of legitimate and illegitimate births and their distribution by color and sex, available since 1900, are presented in table 15. Of the whole number of living births reported within these periods, 6.6 per cent were illegitimate. The proportions of illegitimacy among whites and negroes were 3.1 per cent and 23.8 per cent, respectively. The proportion of males to females was, for total births, among whites as 1.06 to 1 and among negroes, as 1.05 to 1, and for illegitimate births 1.04 to 1 among whites and 1.004 to 1 among negroes.

STILL-BIRTHS.

Still-births have been recorded in the statistical tables in every year since 1812, but not until 1900 were they classified according to sex and color. The recorded data concerning still-births are presented in tables 132, 14, 15, and 126. Nowhere in the records is still-birth defined. It is unlikely that whatever definition custom had established was seriously modified, except under very unusual circumstances. It is probable, therefore, that on the whole until very recent years, a still-birth represented a dead-born fetus of at least 5 full months of utero-gestation. During the last 10 years, due partly to the pressure of the administrative authorities and partly to the request of the department of anatomy of the Johns Hopkins Medical School, physicians have become accustomed to reporting some fetuses of much earlier stages of development.

TABLE 15.—*Number of total, illegitimate and still-births by color and sex, from 1900 to 1920, inclusive.*

Years.	Total births.					Illegitimate.					Still-births.									
	White.		Colored.		Total.	White.		Colored.		Total.	White.		Colored.		Sex unknown.		Color unknown.		Sex and color unknown.	Total.
	M.	F.	M.	F		M.	F.	M.	F.		M.	F.	M.	F.	W.	C.	M.	F.		
1900	3723	3519	695	716	8653	110	100	192	178	580	245	214	119	104	....	....	....	....	....	682
1901	3664	3461	845	825	8795	108	98	243	249	696	236	208	120	108	....	....	....	....	....	672
1902	3653	3540	874	883	8950	160	166	228	225	779	262	188	108	101	....	....	....	....	....	659
1903	3613	3388	815	804	8620	155	150	184	211	700	300	187	144	110	....	....	....	....	....	741
1904	3538	3325	906	830	8599	143	124	232	216	715	249	194	157	110	....	....	....	....	....	710
1905	3629	3448	905	969	8951	154	148	237	258	797	314	241	150	109	....	....	....	....	....	814
1906	3794	3506	887	915	9102	172	143	212	224	751	330	212	152	132	....	....	....	....	....	826
1907	3623	3505	833	800	8761	120	107	209	183	619	273	233	156	132	....	....	....	....	....	794
1908	3833	3731	819	795	9178	142	121	221	212	696	309	246	153	103	....	....	....	....	....	811
1909	3792	3541	742	741	8796	117	116	169	176	578	304	217	159	137	....	....	....	....	....	817
1910	4115	3826	1037	880	9858	159	150	262	246	817	338	212	146	131	....	....	....	....	....	822
1911	3919	3673	824	867	9283	169	177	215	195	756	256	188	156	112	....	....	....	....	....	712
1912	4921	4466	1014	997	11398	217	188	225	242	872	238	176	151	124	....	....	....	....	....	689
1913	5325	4984	1133	1100	12542	186	187	247	224	844	399	182	208	120	....	....	....	....	....	909
1914	5477	5188	965	1007	12637	144	156	214	218	732	414	196	255	161	....	....	....	....	....	1026
1915	5934	5526	1071	1103	13634	175	184	254	279	892	464	307	203	157	....	....	....	....	....	1131
1916	6535	6127	1225	1198	15085	161	164	271	279	875	526	315	243	151	....	....	....	....	....	1235
1917	6441	6141	1215	1153	14950	133	137	272	246	788	527	324	254	160	....	....	....	....	2	1267
1918	6683	6292	1169	1148	15292	114	129	242	262	747	384	248	231	181	127	24	....	1	4	1200
1919	7648	7260	1399	1324	17631	141	115	284	285	825	495	287	217	156	146	21	3	....	2	1327
1920	8159	7775	1436	1417	18787	107	103	317	304	831	498	309	245	153	167	25	....	....	1	1398
Total	101999	96222	20809	20472	239502	3087	2963	4930	4910	15890	7356	4884	3727	2752	440	70	3	1	9	19242

As, with this exception, both before and after 1875, when death and birth certificates were first required, the only reason for reporting still-births would have been to escape charges of infanticide and to secure burial, it is reasonable to suppose that the registration of births of dead-born fetuses was limited to those near or well above viable size and age, i. e., of at least the stage of development compatible with extra-uterine survival of live-born fetuses.

Since for every locality there is generally a very definite relation between the number of live and still births, the proportion of still-births may be expected to fluctuate with the birth-rate, i. e., the proportion of live-born chidren. This has probably varied within wide limits in Baltimore as elsewhere. Another factor of recognized importance, but one which can not be measured here with any degree of exactness, is the variation in the character of obstetrical care and of the inherent maternal qualities of the women. Finally, there must be taken into account the variations in the prevalence of certain general and local diseases which are known to be fatal to fetuses, such as small-pox, influenza, pneumonia, yellow, typhus, and typhoid fevers, syphilis, and gonorrhœa.

In the absence of specific information regarding the true live birth-rate previous to 1916, the frequency of still-births can only be estimated by roundabout methods. From table 132, it will be observed that the rates for recorded still-births as calculated on the basis of the whole population show very wide fluctuations over much of the 109-year period for which they may be followed. The highest and lowest rates recorded were 276 in 1812, and 102 in 1862. The rates declined, but in a rather irregular fashion, from 1812 to 1828, when the low level of 113 was reached. This was a period of heavy mortality from malarial, yellow, and typhus fevers and pneumonia, all of which had fallen considerably by 1828. During this period, in connection with the financial depression following the war, the total birth-rate probably declined sharply. The gradual, but somewhat irregular rise in the rates from 1829 to 1847, when the rate stood between 240 and 258 for this and the next 3 years, and the succeeding decline during the following 12 years to 102 in 1862, suggest a corresponding rise and fall in the birth-rate. The low still-birth rate during and immediately following the Civil War suggests that the total birth-rate declined materially in this period. By 1870 the still-birth rate had risen to 194. The sharp decline in 1873 and 1874 may have been associated with a fall in total birth-rate under the influence of the small-pox epidemic of this time. From 1875 to 1892 the rate for still-births was comparatively high and varied within rather narrow limits. During the period from 1895 to 1915 of very low recorded live-birth rates already alluded to, the still-birth rates were correspondingly low. While this correspondence was perhaps due to low actual birth-rates, it is more than likely that the meager rates were in both cases the direct result of poor registration. It is to be noted that the rates for still-births rose after 1912 and by 1915 had reached the level of 1875–1892, which was maintained from 1916 to 1920. From table 14 it appears that from 1875 to 1920 the ratio of still to the total recorded births, both live and still, varied but slightly from year to year. When the still-birth rate (table 132) is compared with the death-rate for women in child-birth (table 124), both calculated on the basis per 100,000 population, it is found that, with a few notable exceptions, the two rates rose and fell together. These correspondences suggest very

strongly that during the period in which live births have been reported, on an average, whether reporting was complete or incomplete, the registration of still and live births has been maintained at about the same ratio.

During the whole period since 1875 the proportion of still to total reported births has been unusually high, well over 7 per cent. The more exact registration of the last few years gave results not far different, the average for the 6-year period 1915–1920 being 7.4 per cent. For 1919 and 1920 the ratios were 5.9 per cent for whites and 12.8 per cent for negroes. As it is improbable that these proportions have varied widely, it is safe to assume that these remarkably high ratios of still to total births have obtained constantly in Baltimore. From the data compiled in table 15, it is evident that a much larger proportion of still-born fetuses were of the male than of the female sex, the ratios being 1.55 to 1 for whites and 1.35 to 1 for negroes.

Chapter IX.—Statistical Material.

Character; Sources; Uses; Methods.

In the annual reports of the health department, which are preserved since 1827 in continuous series, there are given the amounts of money appropriated for expenses. In the early reports, the appropriations and expenditures are given under separate headings for office administration, salaries of commissioners and clerks, for the quarantine office and station, for the control of nuisances, and for the removal of garbage and the cleaning of streets. As the department expanded after 1870, it is possible to trace and to separate with some degree of accuracy the sums spent on certain activities in connection with attempts to control some of the diseases amenable either to general or specific measures, as for instance, small-pox, tuberculosis, or the communicable diseases as a group, by fumigations, the health warden system, etc. It is possible to find the sums appropriated for the divisions of chemistry, bacteriology, plumbing, or nursing, for example, for terms of years. However, when it comes to the evaluation of any of these activities by themselves, or in groups, it is practically impossible to obtain information sufficiently definite to mean anything when expressed in terms of disease control.

Taking garbage removal as an illustration of a public-health service: In the first place, it was sometimes done by contract, sometimes by laborers appointed by the health department, and sometimes, as after 1882, by a separate department of the city government; in the second place, this function has been inseparably bound up with the cleaning of streets, and from time to time with the cleaning of sewers. The problems of garbage removal, of street cleaning, and of sewer cleaning have varied widely at different periods in the history of the city; the purchasing value of money has also been subject to considerable changes.

If it is sought to estimate the influence of money spent upon the control of the communicable diseases as a group, the sums of the appropriations for the laboratories, the health wardens, fumigation and disinfection, the small isolation hospital and the quarantine station, the nursing and plumbing divisions, and school inspection would not include the whole amount so spent, and comparisons of the per capita cost with the death-rates from these diseases would not bear any accurate relation to each other.

It is not possible to determine the sums expended on water supplies and service, nor to apportion the huge sums invested during late years in the construction and maintenance of a double system of sewers; nor can any correct estimate be made of the cost borne by householders in connecting properties with these sewers. No one who is acquainted with what is known of the history of these matters would attribute any value to such comparisons. All that can be done intelligently in this direction is to attempt in the proper places in relation to the discussion of the courses of certain groups of diseases to picture the conditions obtaining and the specific actions of the health department aimed at

their control at different times. What is wanted in this connection is knowledge of conditions and actions and not inaccurate guesses at the amount of money appropriated at particular times for indefinite services. It is certain that sums appropriated have ever fallen short of the desires and recommendations of the health authorities, and that, in many instances, the city authorities exercised good judgment in this respect.

STATISTICAL NOSOLOGY.

The early statistical nosology was primitive and, as in the old London Bills of Mortality, the deaths were classified in alphabetical order by names of diseases or of prominent symptoms without regard to anatomical, causal, or other relationships, except in the case of fevers, under which heading were grouped together in alphabetical sequence some of the prominent affections of which fever is a conspicuous symptom. This method is well illustrated in the following copy of the list of interments for 1819:

List of interments for 1819.

Abscess	1	Hives	3
Apoplexy	21	Jaundice	2
Asthma	5	Intemperance	46
Burn	2	Insanity	1
Cancer	4	Inflammation of stomach	1
Casualty	17	Inflammation of lungs	29
Childbed	18	Inflammation of bowels	1
Cholera morbus	125	Inflammation of brain	10
Cholic	4	Lockjaw	2
Consumption	272	Measles	116
Convulsions	89	Mortification	26
Cramp in stomach	3	Murdered	7
Croup	57	Old age	77
Decay	88	Palsy	7
Dropsay	41	Pleurisy	41
Do. in the head	27	Rheumatism	5
Drowned	31	Scrofula	2
Dysentery	21	Small-pox	1
Epilepsy	4	Sore throat	11
Fever	4	Spasm	3
bilious	73	Still-born	105
inflammatory	2	Sudden death	16
intermittent	4	Do. by drinking cold water	8
malignant	350	Suicide	3
nervous	2	Syphilis	3
remittent	2	Teething	27
typhus	84	Whooping-cough	78
Flux	5	Worms	59
Fistula	1	Unknown	91
Gravel	3		
Gout	1	Total	2,287
Hæmorrhage	3		

Under 1 year	516	Between 50 and 60 years	71
Between 1 and 2 years	252	Between 60 and 70 years	39
Between 2 and 5 years	129	Between 70 and 80 years	35
Between 5 and 10 years	147	Between 80 and 90 years	27
Between 10 and 20 years	291	Between 90 and 100 years	9
Between 20 and 30 years	357	Over 100 years	1
Between 30 and 40 years	191	Still-born	105
Between 40 and 50 years	117		

There were 1,716 white deaths and 571 colored deaths.

The first indication of an anatomical grouping appeared when, under inflammations, those affecting different organs were grouped together in alphabetical order. This innovation was quite illogical in certain respects, for only a part of the so-called inflammatory diseases were thus treated and no distinction was drawn between acute and chronic affections. The terms inflammation of the lungs, peripneumonia, and pleurisy all may appear in the same table. Acute rheumatism, a febrile and inflammatory affection, was not included under either fevers or inflammation of joints, but appeared as a separate rubic. Abscess also appeared under a separate heading. Scarlet fever was classified with fevers, and measles, mumps, small-pox, and chicken-pox were not. Organic diseases of the heart and angina pectoris were separated by the distance of their initial letters. Cirrhosis of the liver could not be distinguished from abscess of this organ, and abscess of the liver might be hidden under abscess or under inflammation of the liver. This crude nosology admitted of no study of the relative frequency of deaths due to diseases of various organs. The number of items in the list was gradually expanded so that by 1850 they numbered 95; in 1863 they had contracted to 83; there were 106 in 1873, 108 in 1880, 268 in 1890, and 323 in 1898. This expansion was brought about partly by distribution of certain affections among the various organs, as congestion, hemorrhage, abscess, tuberculosis, cancer, tumor, and stone, and by the separation of acute and chronic diseases of certain organs, as the brain, liver, and kidneys. Nephritis first appeared in 1850 and diabetes in 1851. This crude form of classifying deaths has imposed great labor and care in the compilation of the figures for the different causes of death that it is possible to separate out and trace through the whole period. In the early reports a considerable number of deaths were unclassified, being grouped under "causes unknown." As late as 1837, 529 deaths were so grouped, of which 519 were "infantile." Fortunately, the great mass of the deaths assigned to "causes unknown" were in infants, probably recently born for the most part, so that the figures for such diseases as pulmonary tuberculosis, the exanthematous diseases, and other affections which caused the death of older children and adults were not seriously affected by this circumstance. With the introduction of death certificates in 1875, the number of deaths attributed to "causes unknown" greatly decreased.

In the classification of deaths in the annual list of deaths by causes, the officials of the Baltimore health department were completely oblivious to the progress made elsewhere, especially in England, Switzerland, France, and Sweden, under the influence of Farr, D'Espine, Bertillon, and others, and in this country by the committee of the American Medical Association in 1847. Joynes in 1850 (46) and Charles Frick in 1855 (47), in analyzing the deaths in Baltimore classified them according to the latter system, which was evidently largely copied from Farr's, but the force of inertia in the health department was not overcome until 1900. In this year there was a complete change in the statistical nosology, modified from the Bertillon classification, under 15 headings: (1) Epidemic diseases; (2) general diseases, containing a curious mixture; (3) diseases of the nervous system; (4) diseases of the circulatory system; (5) diseases of the respiratory system; (6) diseases of the digestive system; (7) diseases of the genito-urinary system; (8) diseases of the puerperal state; (9) diseases of the skin and cellular tissue; (10) diseases of the locomotor

system; (11) malformations; (12) diseases of infancy; (13) affections of old age; (14) deaths due to violence; (15) causes ill defined. The rubrics were not numbered. In 1902, the first two headings were combined under general diseases. The international classification of the causes of death was adopted in 1903, with the causes of death under 189 headings.

REPORTS OF DEATHS.

Records of deaths have been collected and compiled by the health department since 1797. The annual reports, first issued in 1817, have contained a list of deaths by causes, but with the exception of the report for 1819 preserved in the library of the Medical and Chirurgical Faculty of Maryland, none are available before 1827. Since the latter date the files are complete, those between 1827 and 1849 having been collected and bound in a single volume in the City Library, and those for 1850 and succeeding years are in the health department. Owing to the fortunate circumstance that weekly and annual tables of interment from 1812 to 1832 are to be found in the files of the Baltimore American and Commercial Advertiser, it has been possible to follow the record back to 1812. Since these data correspond in number and classification with those of the annual reports for 1819 and 1827–1832, and with those published from time to time in the Weekly Register by Niles and Russ, they may be regarded as official. The records of the deaths, therefore, are available in unbroken series since 1812.

Before death certificates were required by law in 1875, the tables of interments were compiled from weekly reports made to the health department by the sextons of the cemeteries. The records of the sextons were apparently complete and faithful in regard to color, sex, and age, for even the early tables give data for these. Concerning the causes of death they are less trustworthy, and the number classed as due to "causes unknown," in both infants and adults, forms a large proportion in the tables for the early years.

There is no record of the employment of official searchers to ascertain the causes of death. The cemeteries were either within the city limits or conveniently near. Only when a body was removed to a distance for burial is it probable that the record of the death was missed. Wynne, writing in 1849, expressed the opinion that most of the deaths were returned and that the tables were substantially correct in regard to numbers. As previously stated, the deaths of those dying at the almshouse and at the almshouse hospital, the quarantine (including the so-called marine) hospital, and later the Sydenham Hospital, were not included among the city deaths. These comprised a not inconsiderable number. Since 1900, deaths at the almshouse or Bayview Hospital and Sydenham Hospital have been so included. The deaths among the insane and the tuberculous residents of the city dying at State and private hospitals and sanatoria without the city are not transferred, but are charged against the counties in which these institutions are located. At the sanatoria for the tuberculous, the deaths of city residents have averaged about 125 annually since 1913. Until 1856, the still-born were included with the deaths, but as a separate item.

From the beginning, the reports contained tables giving the number of deaths from all causes by age of decedents, as under 1 year, between 1 to 2

years, 2 to 5 years, 5 to 10 years, and thereafter decennially. The deaths are classified by race for white and colored (colored divided into free and slave), and by sex for the total. It is not possible to determine with accuracy the number of deaths by color and sex until 1857, because, before that date, in the special tables of deaths for color and sex as set up, still-births were included and males and females were not separated as to color. Therefore, until 1857, the rates for white and colored as calculated in the tables presented are of necessity based upon figures for deaths inclusive of still-births. In the early years the deaths of colored free and slaves were not classified by sex. Since 1857, deaths from all causes are classified by sex and color in correlated form. It has not been possible to obtain any of the original reports of the sextons to the health department.

The form of death certificate first in use after the law of 1875 called for the name, address, age, sex, race (white or colored), birthplace, duration of illness, cause of death, and signature of the attending physician. Since deaths recorded in 1874 and 1875 show no considerable variation in number, either for all causes or for the more important causes of death, it is likely that under the previous system not many deaths within the city were unrecorded. With the passage of time, the information required on the death certificates was made more comprehensive, and in 1899 the standard death certificate was adopted.

STATISTICAL STUDIES RELATING TO CAUSES OF DEATH.

It is notable that though in the early reports attention is directed from time to time to an unusually large number of deaths ascribed to some particular diseases, such as cholera, yellow fever, small-pox, typhus fever, measles, scarlet fever, or to the high mortality of infants, it was not until 1875 that any real use was made of statistical methods in the Baltimore health department to determine the relative importance of different diseases as causes of death, and only in occasional years were even the crude death-rates calculated. This omission is the more curious because Wynne in 1849, Levin S. Joynes in 1850, and Charles Frick in 1855 published interesting studies of mortality in Baltimore, in relation to age, sex, and race, and discussed in an enlightened manner the relation of various diseases and disease groups to the annual mortality.

Crude mortality-rates for deaths from all causes appear annually in the reports since 1875. In this year, Commissioner Steuart compared the rates for Baltimore with those of some 40 other cities, and in 1879 he compiled a table of the annual mortality rates for 1873 to 1879 and discussed some of the chief contributory factors. However, in these discussions, as well as those of succeeding years until 1916, with certain notable exceptions to be reviewed later, reported cases and deaths of particular diseases were recorded only in absolute figures and not in relation to numbers actually exposed.

From 1883, the reports abound in statistical tables of the causes of death. The earliest gives annually from 1830 to 1883 the total deaths from all causes, total deaths under 5 years of age, and the total deaths from "zymotic diseases," with the percentage of deaths of children under 5 years to the total deaths. In 1884, tables were introduced giving the total number of deaths by months in each ward; the weekly deaths from pulmonary tuberculosis by color and sex from 1875; the annual mortality rates from all causes and from pulmonary

tuberculosis, according to race (white and colored) and sex from 1875 to 1884, with the mean temperature and humidity of the atmosphere; a comparative table of the deaths from all causes and for pulmonary tuberculosis among males and females, white and colored for the 10-year period; tables of the number of deaths in each ward for each week in 1884 from pneumonia, pulmonary tuberculosis, and from the various "zymotic diseases."

In the next year these tables were supplemented by one giving the number of deaths from cancer from 1830 to 1884, inclusive. Additional tables were presented in 1886 and in the years immediately succeeding, giving the annual number of deaths since 1875 from typhoid fever as occurring among males, females, native and foreign white, and colored; the number of deaths from 25 "zymotic" diseases in each ward by months; the total number of deaths in each ward, according to sex, nativity, and race; and the deaths by occupation of the decedents.

The report for 1888 carried an interesting chart, giving annually the number of deaths from cholera infantum in children under 5 years of age from 1830 to 1888, inclusive, and a similar one for scarlet fever and for small-pox. In this year the commissioner of health, reviewing the mortality from "zymotic" diseases, pointed out that the percentage of deaths from these diseases to the total mortality from all causes had fallen from the average of 28 per cent during the 48 years from 1836 to 1883 to an average of 22 per cent for the 5-year period, 1884 to 1888. For certain specific diseases, the drop in the average annual number of deaths was as follows: Scarlet fever from 227 to 57; diphtheria (14 years from 1870 to 1883) from 469 to 143; typhoid fever (24 years from 1860 to 1883) from 190 to 155. These or similar tables, in which total mortality or mortality from separate diseases or disease groups are compared, almost invariably in absolute figures of the numbers of deaths, are features of the health department reports to the present day.

Since 1903, the reports have been supplemented by other raw-data tables, dealing with diphtheria, scarlet fever, measles, whooping-cough, gastro-enteritis in children, lobar- and broncho-pneumonia and bronchitis, pulmonary and other forms of tuberculosis, chronic nephritis, organic diseases of the heart, and cancer. In these tables are given the absolute number of deaths, mostly by age, sex, color, occupation, and ward, but, since for any particular disease, the data are distributed over at least three tables and arranged in each separate table in relation to only two or at most three categories, the material is relatively useless for comparative study. From some of these tables, however, it is possible to arrange new tables from which there may be calculated, for the census year 1910, rates specific in regard to age, sex, and color, for certain affections.

Between 1903 and 1915, Dr. C. Hampson Jones made interesting comparative studies, using sometimes rates and sometimes absolute figures, of certain principal causes of death, notably of tuberculosis, typhoid fever, pneumonia, diarrhœa and enteritis in children, Bright's disease, and organic heart disease, in relation to age, sex, and color.

In the annual summary of vital statistics, which for many years has been given in connection with the mortality tables, only the births and total deaths are expressed in rates, the deaths from prominent communicable and other important affections being given only in absolute figures.

RECORDS OF MORBIDITY.

Records of morbidity are scanty and incomplete before 1898. In years of severe epidemics of yellow fever, cholera, and small-pox, some reports of the number and distribution of cases were obtained, but it is doubtful if these were ever complete. Quinan chronicled the figures for cases of small-pox during some of the early epidemics. In the reports of the consulting physician, or of the president of the board of health, in the earlier years, the absence or presence of cases of small-pox, of cholera, or of yellow fever are often noted. Even in the extensive epidemic of small-pox in 1872–1873, though cases were searched out by the police and health wardens, and physicians reported cases voluntarily, the annual reports fail to record the number of cases. In the report for 1882 it is stated that 4,000 cases of small-pox were discovered in 1872, and that probably an equal number of cases were concealed. It can not be said that there were any morbidity statistics, even for small-pox, in the Baltimore health department until 1882. Not until after 1894 was there any serious effort made to record data for and to utilize morbidity statistics in the health department. Between 1898 and 1915, Dr. Jones used morbidity data in the study of typhoid fever, and Dr. Stokes, in his annual reports, used morbidity rates in his studies of the influence of diphtheria antitoxin and the diphtheria-culture test upon the prevalence of diphtheria, and of the relation of water and milk to typhoid fever. It can not be said, however, that before 1916 any attempt was made to apply data of morbidity routinely to problems of public-health administration in Baltimore.

The reporting of communicable diseases, with the exception of pulmonary tuberculosis, measles, mumps, and whooping-cough, has been fairly full and accurate since 1898, and the data for all of the reportable diseases has been compiled by weeks and months since this date.

The annual reports of the quarantine officer, since 1832, contain tables giving the numbers of cases and deaths at the station. Many of these included, of course, individuals sent from the city ill with small-pox and typhus fever.

The extensive tables of defects found in routine examinations of school children by the medical inspectors and published annually since 1907 present the data in absolute figures only.

STATISTICAL METHOD.

Unless indicated otherwise, all rates for natality, mortality, and morbidity presented in this work are calculated on the basis of 100,000 living population. Decimal fractions 5 and over have been absorbed by the whole number and those below 5 have been disregarded. As they are commonly without significance, with few exceptions, rates amounting to less than 1 per 100,000 have not been entered in the statistical tables. For convenience in typography, the initial letters C, D, and R are used to signify the words case, death, and rate in the tables of morbidity and mortality. Rates for the total population and those specific for color and sex are calculated on the populations in table 12, and those specific for age, color, and sex on the populations in tables 10 and 11. Certain rates for deaths under 1 year and for maternal morbidity are based on data of table 14. Unless otherwise indicated, the rubric numbers referred to in the text are those of the international classification of the Causes of Death, revision of 1909.

PART V.—THE FEBRILE DISEASES.

Chapter X.—Nuisance Diseases.

1. Insect-borne diseases: Malaria; Yellow fever; Typhus fever. (Tables 16, 18, graphs 2-4.)
2. Acute inflammatory affections of the intestinal tract characterized by frequent loose stools of abnormal composition: Diarrhœa; Dysentery; Asiatic cholera; Typhoid fever. (Tables 19 to 33, graphs 5 to 10.)

INSECT-BORNE DISEASES.

Of the diseases spread from man to man through the media of biting or stinging insect hosts as vectors, malarial, yellow, and typhus fevers are the only ones of practical importance in Baltimore. Only one death, in 1879, has been recorded from relapsing fever, and bubonic pest, trypanosomiasis, and other diseases of this class have never been recognized in Baltimore.

MALARIAL FEVERS.

Malaria was common in Maryland for many years before Baltimore was founded, but very little information exists concerning the prevalence and severity of the malarial diseases in Baltimore Town before 1794, and then they are mentioned only incidentally in connection with yellow fever as perennially present, in varying intensity in the summer and fall, particularly along the water-front, and especially at Fell's Point. Davidge, Reese, Coulter, Potter, and others in their reports and other writings on yellow fever, between 1798 and 1821, constantly referred to the "common intermittent, remittent, and bilious remittent fevers," associated often with dysentery and present every year at Fell's Point and along Jones Falls. They attributed these fevers to noxious vapors arising from decaying vegetable material in the numerous ditches, ponds, pools, and dock-slips at Fell's Point and in the basin and in the marshes along the latter and Jones Falls and Harford Run.

These annual summer and fall fevers, either intermittent or remittent in type, varied much in severity not only from year to year but in any particular season, and were described as being of a much more severe type in the late summer and early fall than in June, when they made their first appearance. Yellow discoloration of the skin and vomiting of bile (or broken-down blood mistaken for bile) were common characteristics of the remittent form so commonly termed "bilious fever." These characteristics caused this type of malarial fever to be confused in certain years with true yellow fever, which even so good an observer as Davidge held to be only an accentuation of the familiar bilious remittent. From the descriptions of the intermittent and of the usual remittent fevers, as well as from their successful treatment with preparations of cinchona bark, it is fair to conclude that these fevers were for the most part true malaria. That bilious or bilious remittent fever was a synonym for remittent malarial fever appears certain from the writings of Davidge, Potter, Bartlett (48), and Jameson (49). The latter described an epidemic of bilious remittent fever, occurring in 1804, that was successfully curbed by treatment with "the bark."

The great expansion of ocean commerce between Baltimore and the West Indies, after the Revolutionary War, and later with the Southern States and with South America, must have insured the annual importation of cases of the severer grades of tropical and subtropical malaria, from which infection was spread by mosquitoes abounding at Fell's Point and the lower-lying sections about the basin and the streams flowing into it. The topography of the city and the imperfect drainage, due to the poor grading, pavements, and gutters, afforded abundant opportunities for large and small mosquito-breeding pools. The standing water in many cellars furnished another set of breeding places. According to the annual health report for 1824, there was a marked decrease in autumnal sickness in the neighborhood of Eden Street and Harford Run after filling in and running a drain which did away with standing water, and it was noted that the "French drains" constructed in various parts of Fell's Point acted well and the inhabitants suffered much less with autumnal fever than in the preceding fall.

In his work on epidemic cholera at the Baltimore almshouse in 1849, Thomas H. Buckler (11) gave a map (2) of the medical topography of Baltimore in 1851, on which the whole territory south and southeast and west of the city bordering on the Patapsco River, Curtis Bay, and the middle branch is marked "Region of intermittent and remittent fever." The northern limit of this area was bounded by the "mine banks," or iron-ore deposits; on the west side it followed the general course of the Baltimore and Ohio Railroad, and on the east side the Philadelphia Turnpike, just north of the Baltimore, Wilmington, and Philadelphia Railroad. At the almshouse, situated to the west of the northern border of the city, "intermittent and remittent bilious fevers were spontaneous in their origin (among the inmates) almost every season, while the country for a mile or two around enjoyed a comparative immunity from these affections. Besides the indigenous origin of malarious fevers, a very large number of intermittents are brought in every season, and also remittents, in the autumn of some years, from the iron-ore mine-banks, of the Washington and Philadelphia Roads." That the remittent fever of this period at the almshouse was continuous malarial fever is attested by the notes of William T. Howard, sr., a medical resident there in 1843, in which was recorded a clear-cut clinical history of a fatal case with a full autopsy protocol of a man from the "mine bank." This case was also reported by Swett (50) of New York. Anderson and Frick (51), resident physicians at the almshouse during the summer of 1844, autopsied 12 cases of remittent fever, which were analyzed by Alfred Stille in 1845. Ten of these 12 cases came from the mine-banks. Buckler recorded that in 1851 a grave epidemic of intermittent and remittent fevers prevailed, as a new feature of the medical history of this locality, on both sides of Jones Falls, north of Centre Street, and at the Maryland Penitentiary. The outbreak of malarial fevers in this locality was attributed by Buckler to the vast quantities of filth in the bed of the falls, the stream of which was rendered sluggish in the dry season by the diversion of so large a proportion of its water to supply the reservoir, situated above at the Belvedere Bridge. That malarial fevers were rife between 1870 and 1885 at Fell's Point and along the uncovered portions of Harford Run, in the northwestern section of the city, is evident from the text of the reports of the commissioners of health. Dr. Alexander C. Abbott is authority for the statement that in the latter area between 1870 and 1880

large numbers of newly built houses were vacated by their tenants because of the great prevalence of severe malarial fever. Between 1889 and 1895, many individuals with malaria living in various parts of the city, and from the surrounding territory on or near the water, particularly at Sparrow's Point, applied to the dispensaries of the Maryland University and Johns Hopkins Hospital. At Bayview Asylum the experience of the former almshouse was repeated between 1866 and 1900.

There is no doubt that from its early history until about 1895 malarial fevers were very prevalent in and around Baltimore; within the city its chief prevalence was about the harbor, docks, basin, Jones Falls, Harford Run, and probably along the courses of Schroeder's and Chatworth's Runs. In these portions of the city conditions were particularly favorable for mosquito breeding, not only because of standing water in and about docks, in streams and marshes, and in the streets, gutters, alleys, and yards of low-lying valleys, but in cellars. Much malaria was doubtless imported from the Southern States and the West

TABLE 16.

Year.	No. of specimens.	No. of positive specimens.	Year.	No. of specimens.	No. of positive specimens.
1903	272	4	1912	513	52
1904	308	2	1913	746	5
1905	406	2	1914	437	4
1906	587	11	1915	417	4
1907	526	17	1916	476	3
1908	491	6	1917	247	1
1909	371	1	1918	79	1
1910	497	1	1919	60	1
1911	507	17	1920	48	1

Indies and South America and from rural districts of tidewater Maryland and Virginia, particularly by summer visitors from the city.

The reports of the quarantine officers show that malaria in fatal form not infrequently attacked those ill with small-pox or typhus fever sent from the city to the old Marine Hospital, particularly in the fifth and sixth decades of the nineteenth century. At this period many cases of severe malaria were taken from vessels from southern ports, including Central America. Malaria was so prevalent at the quarantine station that for many years, and until at least 1890, the officers and employees were regularly dosed with quinine in whisky.

The decrease in the number of deaths from malarial diseases since 1900 has been associated with a decrease in the number of recognized cases in dispensary and hospital practice and in the experience of leading clinicians. The figures of examinations of blood for diagnosis in the bacteriological laboratory since 1903 are shown in table 16. From table 16 it is evident that until 1918 malaria was frequently suspected by physicians. The percentage of cases in which the tentative diagnosis was confirmed was relatively small. It was 2.5 per cent between 1903 and 1912, and 0.8 per cent between 1913 and 1920. In the first period there were two well-marked minor epidemics, each covering a period of two years.

Deaths from malarial fevers have been classified in the annual reports under six headings: (1) intermittent fever, (2) remittent fever, (3) bilious fever, (4) congestive fever, (5) malarial fever, and (6) typho-malarial fever. This classification has been influenced by variations in fashion in both medical and statistical nosology. The absolute figures and the rates (except for typho-malarial fever, omitted for reasons given later) are set forth in table 17. From a study of these, in connection with graph 2, an approximate idea of the course of malarial fevers in Baltimore is attained. It is evident that intermittent fever is the only variety that can be followed continuously throughout the series of years. With the exception of 1816, from 1815 until 1909, it appears each year as a cause of death. This form of malaria, on account of the characteristic paroxysms of chill, fever, and sweating, occurring usually at regular intervals measured in days, with its afebrile intermissions, was relatively easy of diagnosis, and, of the group of malarial diseases, the one least likely to be confused with other febrile affections, malarial and non-malarial, and for these reasons the figures and rates for this disease may be regarded as a fairly close approximation to the truth.

Attention is directed to the fact that intermittent fever has been a factor of considerable weight in the death-rate, in one year (1821) having a rate of 30 and in 2 years (1871 and 1872) surpassing this figure, while in a number of years (1821, 1822, 1829, 1834, 1837, 1842, 1864, 1867, 1868, 1869, 1870, 1871, 1872, 1873, and 1874) its rate was over 10.

The peaks in the curve for intermittent fever follow rather closely, but not exactly, those of the curves for bilious fever and for the total of the malarial diseases. With the exception of 1820, when there were 24 deaths recorded under this heading (with a rate of 41), remittent fever has not been credited with any large contributions to the malarial deaths in Baltimore.

To bilious fever, the old synonym for continuous or remittent fevers, in contrast to intermittent malarial fevers, the great bulk of the deaths ascribed to malaria were assigned from the beginning of our records until 1875. In the latter year (the date, by the way, of the first use in Baltimore of death certificates signed by physicians) it practically dropped out of the local statistical nosology, the deaths which previously would have been so ascribed being from this date classed under malaria and remittent fever. A few deaths, however, were thus classified as late as 1885. The number of deaths attributed to bilious fever in the earlier years, say between 1812 and 1819, inclusive, is greater than that attributed to any other single cause affecting all ages, with the exception of consumption. During these 8 years, the deaths from the former averaged about 12 per cent, and those from the latter about 17 per cent of the total deaths from all causes. It is certain that before 1851, and probably after that date, deaths from various causes other than severe continued malarial fever were classed under bilious fever. In the first place, owing to the belief so firmly held in the early part of the nineteenth century by certain Baltimore physicians that yellow fever was an accentuated form of continued malarial fever, it is extremely probable that not only in years of clearly recognized epidemics of yellow fever, but in other years, at least until 1875 some cases of true yellow fever, perhaps in atypical form, were called bilious fever. It is probable, indeed, that in severe cases, and particularly when fatal, the diagnosis between yellow and bilious remittent malarial fever was difficult, or even

impossible. In the second place, as recorded by Davidge, dysentery, which so often occurred in the same individual concurrently with malaria and was by many believed to be a part of the malarial process, may have swollen the bilious-fever death-list. In the third place, it is likely that until 1850 and for years after, bilious fever shared with remittent fever, diarrhœa, and inflammation of the bowels as classification categories for typhoid fever. In the fourth place, it is not unlikely that during the early period some of the deaths from other severe affections characterized by high fever of a remittent type, such as acute endocarditis, pyemia, septicemia, and even typhus fever, were assigned to bilious fever. On the other hand, the leading physicians, Drs. Allenby, Coulter, and W. H. and W. A. Clendenin, in practice at Fell's Point, the chief home within the city of bilious fever, were men of ability and discernment.

Deaths classed under congestive fever are considered to have been due to that acute form of virulent malaria characterized by severe chill, very high fever, delirium, coma, a prostration comparable to that of surgical shock, and by massive infection (often particularly marked in the cerebral capillaries) by malarial organisms of the æstivo-autumnal type. Synonymous with the dreaded " congestive chills " and the pernicious malarial fever of the Southern States and the tropics, appearing in the local statistical nosology first in 1836, it was credited with death in every year (with the exception of 1848, 1855 to 1860, 1862, and 1876) until 1884. Its most conspicuous part was played between 1870 and 1874 (with death-rates above 10 in 1871–1873) towards the end of the great wave of malaria beginning in 1862 and ending abruptly in 1875.

The term *malaria* first appeared in the local statistical nosology in 1877, and disappeared in 1902 to reappear from 1910 to 1920. As is clear from table 17, it was used indiscriminately for the other nosology categories applying to malarial affections. Its curve follows closely that of deaths for all forms of malaria.

Typho-malarial fever made its first appearance among the causes of death in the Baltimore health reports in 1876, with 32 deaths. With the exception of the following 2 years, it was credited with deaths until 1898. During this period, the number of deaths assigned to this cause varied from 12 in the latter year to 75 in 1885. It is impossible to determine what proportion of the deaths recorded under this category was due to typhoid fever alone, to malaria alone, to a combination of these two diseases, to malaria and other diseases, or to other diseases without malaria. That typhoid fever and malaria may exist in the same individual has long been clearly established, and is quite likely that, when in combination, an attack of typhoid fever, from which recovery would otherwise have occurred, might be determined to a fatal issue by the complicating malaria. Further, it is probable that in Baltimore typhoid fever not infrequently attacked individuals who were the subjects of chronic or latent malaria, and that, in this case, just as is known to happen in the course of pneumonia, fractures, and other pathological conditions, the dormant malarial infection may show an exacerbation. With all these considerations in view, it has seemed, on the whole, wiser to omit the deaths ascribed to typho-malaria from consideration here and to include them with typhoid fever.

When the curve for malaria as a whole is reviewed (graph 2), two points stand out conspicuously, its shape and height. The curve of the annual rates for total deaths is divided into four large waves, the first and highest beginning

TABLE 17.—*Number of deaths and rate of death per 100,000 living inhabitants, from malarial fevers, yellow fever, typhus fever, and total insect-borne diseases, and the percentage of total insect-borne diseases of total deaths, from 1812 to 1920, inclusive.*

D = death. R = rate.

Year.	Malarial fevers.												Yellow fever.		Typhus fever.		Total.		Percentage of total deaths.
	Intermittent fever.		Remittent fever.		Bilious fever.		Congestive fever.		Malarial fever.		Total.								
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	
1812	....	....	....	....	99	242	....	....	....	....	99	242	....	....	....	....	99	242	8
1813	....	....	....	....	83	194	....	....	....	....	83	194	....	....	1	2	84	196	7
1814	....	....	....	....	113	253	....	....	....	....	113	253	....	....	56	125	169	378	15
1815	5	11	....	....	67	143	....	....	....	....	72	154	....	....	85	182	157	336	12
1816	....	....	....	....	58	119	....	....	....	....	58	119	....	....	28	57	86	176	7
1817	1	2	....	....	78	153	....	....	....	....	79	155	....	....	26	51	105	206	8
1818	6	11	1	2	70	132	....	....	....	....	77	145	....	....	85	160	162	305	9
1819	4	7	2	4	73	132	....	....	....	....	79	142	350	631	84	151	513	925	24
1820	5	9	24	41	54	93	....	....	....	....	83	143	....	....	73	126	156	270	10
1821	18	30	3	5	160	265	....	....	....	....	181	300	4	7	33	55	218	362	11
1822	12	19	....	....	358	570	....	....	....	....	370	589	....	....	40	64	410	653	19
1823	5	8	1	2	137	209	....	....	....	....	143	219	....	....	148	226	291	445	15
1824	5	7	2	3	62	91	....	....	....	....	69	101	....	....	111	163	180	264	13
1825	1	1	....	....	78	110	....	....	....	....	79	112	....	....	50	71	129	182	9
1826	6	8	....	....	113	153	....	....	....	....	119	162	....	....	44	60	163	221	9
1827	2	3	....	....	66	86	....	....	....	....	68	89	....	....	35	46	103	134	7
1828	5	6	....	....	70	88	....	....	....	....	75	94	....	....	21	26	96	121	6
1829	9	11	....	....	76	92	....	....	....	....	85	103	....	....	28	34	113	137	6
1830	6	7	....	....	58	68	....	....	....	....	64	75	....	....	33	39	97	113	5
1831	2	2	....	....	117	132	....	....	....	....	119	134	....	....	39	44	158	178	7
1832	7	8	....	....	89	97	....	....	....	....	96	104	....	....	54	59	150	163	4
1833	5	5	....	....	59	62	....	....	....	....	64	67	....	....	23	24	87	91	4
1834	19	19	....	....	86	87	....	....	....	....	105	106	....	....	31	31	136	138	5
1835	1	1	....	....	65	63	....	....	....	....	66	64	....	....	27	26	93	91	5
1836	3	3	....	....	83	78	3	3	....	....	89	84	....	....	41	39	130	123	6
1837	14	13	....	....	32	29	2	2	....	....	48	44	....	....	14	13	62	57	2
1838	3	3	....	....	37	33	6	5	....	....	46	41	....	....	33	29	79	70	3
1839	1	1	....	....	46	39	4	3	....	....	51	44	....	....	20	17	71	61	3
1840	2	2	....	....	49	40	7	6	....	....	58	48	....	....	13	11	71	59	3
1841	4	3	....	....	38	30	10	8	....	....	52	42	....	....	18	14	70	56	3
1842	14	11	....	....	68	53	7	5	....	....	89	69	....	....	19	15	108	84	4
1843	5	4	2	2	38	29	11	8	....	....	56	42	....	....	8	6	64	48	3

1844	3	2	1	1	43	31	4	3	....	....	51	37	....	....	19	14	70	51	3
1845	3	2	3	2	53	37	4	3	....	....	63	45	....	....	17	12	80	57	3
1846	2	1	....	....	70	48	7	5	....	....	79	54	....	....	20	14	99	68	3
1847	3	2	....	....	44	29	1	1	....	....	48	32	....	....	135	90	183	122	5
1848	2	1	1	1	52	34	....	....	....	....	55	36	....	....	83	54	138	89	4
1849	11	7	3	2	65	41	2	1	....	....	81	51	....	....	156	98	237	149	6
1850	9	5	2	1	48	29	2	1	....	....	61	37	....	....	107	65	168	102	4
1851	2	1	....	....	38	23	4	2	....	....	44	26	....	....	24	14	68	40	2
1852	6	3	....	....	53	31	3	2	....	....	62	36	....	....	18	10	80	46	2
1853	18	10	....	....	72	40	5	3	....	....	77	43	18	10	17	10	112	63	3
1854	13	7	....	....	97	53	4	2	....	....	94	51	20	11	19	10	133	73	2
1855	16	9	....	....	63	33	....	....	....	....	79	42	13	7	12	6	104	55	2
1856	5	3	....	....	45	23	....	....	....	....	50	26	....	....	10	5	60	31	1
1857	9	5	....	....	37	19	....	....	....	....	46	23	....	....	7	4	53	27	1
1858	4	2	....	....	37	18	....	....	....	....	41	20	....	....	1	....	42	21	1
1859	2	1	....	....	64	31	....	....	....	....	66	32	....	....	3	1	69	33	1
1860	1	....	....	....	34	16	....	....	....	....	35	16	....	....	1	....	36	17	1
1861	6	3	....	....	33	15	9	4	....	....	48	22	....	....	....	....	48	22	1
1862	7	3	....	....	28	12	....	....	....	....	35	16	....	....	3	1	38	17	1
1863	20	9	....	....	41	18	1	....	....	....	62	27	....	....	1	....	63	27	1
1864	30	13	....	....	30	13	1	....	....	....	61	26	....	....	3	1	64	27	1
1865	24	10	....	....	38	16	3	1	....	....	65	27	....	....	2	1	67	28	1
1866	18	7	....	....	33	13	5	2	....	....	56	23	....	....	12	5	68	27	1
1867	30	12	....	....	26	10	4	2	....	....	60	24	....	....	27	11	87	34	2
1868	51	20	....	....	34	13	5	2	....	....	90	35	....	....	2	1	92	35	1
1869	60	23	....	....	44	17	13	5	....	....	117	44	27	10	1	....	145	54	2
1870	62	23	....	....	53	19	9	3	....	....	124	45	....	....	18	7	142	52	2
1871	88	32	....	....	77	28	36	13	....	....	201	72	....	....	29	10	230	82	3
1872	90	32	....	....	71	25	31	11	....	....	192	67	....	....	1	....	193	68	2
1873	75	26	....	....	62	21	30	10	....	....	167	57	....	....	4	1	171	59	2
1874	60	20	14	5	52	17	26	9	....	....	152	51	....	....	8	3	160	54	2
1875	18	6	22	7	1	....	2	1	....	....	43	14	....	....	13	4	56	18	1
1876	14	5	22	7	2	1	....	....	....	....	38	12	44	14	6	2	88	28	1
1877	13	4	10	3	1	....	2	1	4	1	30	9	....	....	13	4	43	14	1
1878	14	4	22	7	2	1	4	1	13	4	55	17	....	....	....	....	55	17	1
1879	12	4	22	7	1	....	1	....	15	5	51	15	....	....	1	....	52	16	1
1880	19	6	18	5	4	1	1	....	30	9	72	21	....	....	7	2	79	23	1
1881	10	3	17	5	6	2	6	2	58	17	97	28	....	....	....	....	97	28	1
1882	14	4	8	2	4	1	1	....	69	20	96	27	....	....	3	1	99	28	1
1883	13	4	11	3	3	1	4	1	56	16	87	24	....	....	2	1	89	25	1
1884	15	4	14	4	2	1	....	....	61	17	92	25	....	....	1	....	93	25	1
1885	12	3	15	4	1	....	....	....	61	16	89	24	....	....	....	....	89	24	1
1886	3	1	27	7	....	....	....	....	61	16	91	24	....	....	....	....	91	24	1
1887	12	3	16	4	....	....	....	....	55	14	83	21	....	....	....	....	83	21	1

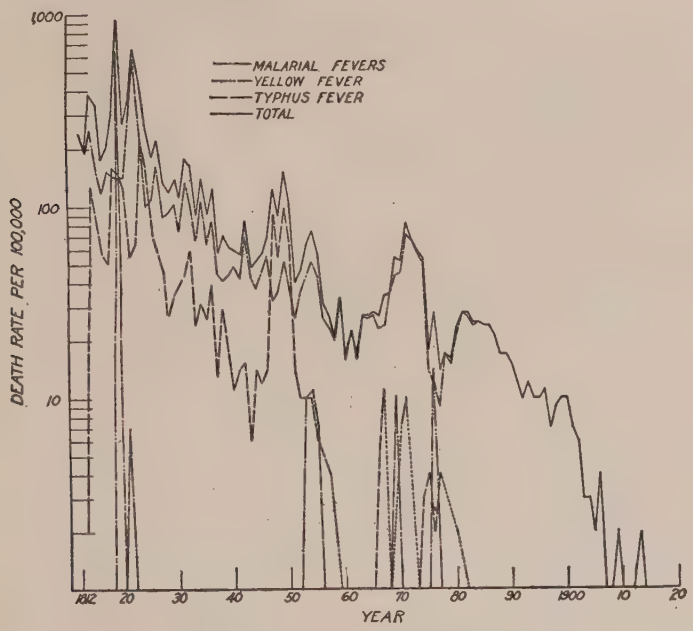
TABLE 17.—*Number of deaths and rate of death per 100,000 living inhabitants, from malarial fevers, yellow fever, typhus fever, and total insect-borne diseases, and the percentage of total insect-borne diseases of total deaths, from 1812 to 1920, inclusive*—Continued.

D = death. R = rate.

Year.	Malarial fevers.												Yellow fever.		Typhus fever.		Total.		Percentage of total deaths.
	Intermittent fever.		Remittent fever.		Bilious fever.		Congestive fever.		Malarial fever.		Total.								
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	
1888	7	2	17	4	....	....	....	....	46	11	70	17	....	....	....	....	70	17	1
1889	7	2	16	4	....	....	....	....	49	11	72	17	....	....	....	....	72	17	1
1890	4	1	15	3	....	....	....	....	47	11	66	15	....	....	....	....	66	15	1
1891	5	1	21	5	....	....	....	....	27	6	53	12	....	....	....	....	53	12	1
1892	8	2	11	2	....	....	....	....	24	5	43	10	....	....	....	....	43	10	..
1893	11	2	14	3	....	....	....	....	28	6	53	12	....	....	....	....	53	12	1
1894	5	1	19	4	....	....	....	....	21	5	45	10	....	....	....	....	45	10	..
1895	7	1	16	3	....	....	....	....	25	5	48	10	....	....	....	....	48	10	..
1896	12	3	17	4	....	....	....	....	25	5	54	11	....	....	....	....	54	11	1
1897	7	1	10	2	....	....	....	....	16	3	33	7	....	....	....	....	33	7	..
1898	6	1	11	2	1	....	....	....	25	5	43	9	....	....	....	....	43	9	..
1899	41	8	....	....	....	....	....	....	7	1	48	10	1	....	....	....	49	10	..
1900	49	10	....	....	....	....	....	....	4	1	53	10	....	....	....	....	53	10	1
1901	31	6	....	....	....	....	....	....	5	1	36	7	....	....	1	....	37	7	..
1902	31	6	....	....	....	....	....	....	....	....	31	6	....	....	....	....	31	6	..
1903	18	3	....	....	....	....	....	....	....	....	18	3	....	....	....	....	18	3	..
1904	18	3	....	....	....	....	....	....	....	....	18	3	....	....	....	....	18	3	..
1905	11	2	....	....	....	....	....	....	....	....	11	2	....	....	....	....	11	2	..
1906	22	4	....	....	....	....	....	....	....	....	22	4	....	....	....	....	22	4	..
1907	5	1	....	....	....	....	....	....	....	....	5	1	....	....	....	....	5	1	..
1908	8	1	....	....	....	....	....	....	....	....	8	1	....	....	....	....	8	1	..
1909	10	2	....	....	....	....	....	....	....	....	10	2	....	....	....	....	10	2	..
1910	....	....	....	....	....	....	....	....	8	1	8	1	....	....	....	....	8	1	..
1911	....	....	....	....	....	....	....	....	4	1	4	1	....	....	....	....	4	1	..
1912	....	....	....	....	....	....	....	....	8	1	8	1	....	....	1	....	9	2	..
1913	....	....	....	....	....	....	....	....	9	2	9	2	....	....	....	....	9	2	..
1914	....	....	....	....	....	....	....	....	6	1	6	1	....	....	....	....	6	1	..
1915	....	....	....	....	....	....	....	....	1	....	1	....	....	....	....	....	1	....	..
1916	....	....	....	....	....	....	....	....	2	....	2	....	....	....	....	....	2	....	..
1917	....	....	....	....	....	....	....	....	2	....	2	....	....	....	....	....	2	....	..
1918	....	....	....	....	....	....	....	....	1	....	1	....	....	....	....	....	1	....	..
1919	....	....	....	....	....	....	....	....	3	....	3	....	....	....	....	....	3	....	..
1920	....	....	....	....	....	....	....	....	1	....	1	....	....	....	....	....	1	....	..

before 1812, reaching its peak in 1822 with the extraordinary rate of 589 and its low point in 1838 with a rate of 41; the second and much lower wave culminating in 1862 with its highest peak, a rate of 69, in 1842; the third, showing at its peak in 1871 a rate of 72 and ending in 1877 with a rate of 9, the lowest in the city's history; and the fourth, beginning in 1878, rising gradually to a rate of 28 in 1881 and falling by gradual stages to a negligible value in 1915.

The first two waves possess striking characteristics which are lacking in the last two, namely, multiple subsidiary peaks and depressions of great height and depth, and, during the years covered by them—1812 to 1862—bilious fever is the great contributory element, the curve for this cause being almost as high as that for the total for malarial diseases, with which it closely conforms. In



GRAPH 2 (from table 17). Annual crude mortality rates from insect-borne diseases, 1812 to 1920, inclusive.

the first great wave the peaks of the subsidiary waves are separated by intervals of from 1 to 4 years. Between the extraordinarily high peak of 1822 and the next one in 1826 there is an interval of 4 years, the rate for 1824, the mid-year, falling from 589 to 101. The time intervals between the subsidiary peaks and depressions of the second great wave are about the same as those of the first, but the peaks are without exception all lower than the depressions of the first great wave. In both the first and second waves a straight line would almost connect the points marking the rates for the years of depression, and the slant of the line in each instance would be acute, much more so, however, for the low points of the first than of the second wave. With the ending of the second wave, malaria, as a cause of death in Baltimore, had come to play a comparatively subsidiary rôle. Thus, these two waves are characterized by multiple epidemics of fatal malarial fever, in which the remittent type—now

called æstivo-autumnal—commonly classified as bilious, but sometimes as remittent (1819–1821, 1824, 1844, 1845, 1848–1850) and sometimes as congestive (1836–1847, 1850–1854), played overwhelmingly the principal rôle. When the rates for all forms of malaria are averaged for 5-year periods (table 18, graph 3) the course of the disease may be followed with greater ease. From a level of 211 for the period ending in 1815, the rate fell to 141 in 1816–1820 and rose to 264 in 1821–1825. From the highest point the rate fell continuously but by somewhat uneven gradations to 23 in 1856–1860. Remaining stationary during the Civil War period, the rate rose during the next decade to 52 in 1871–1875.

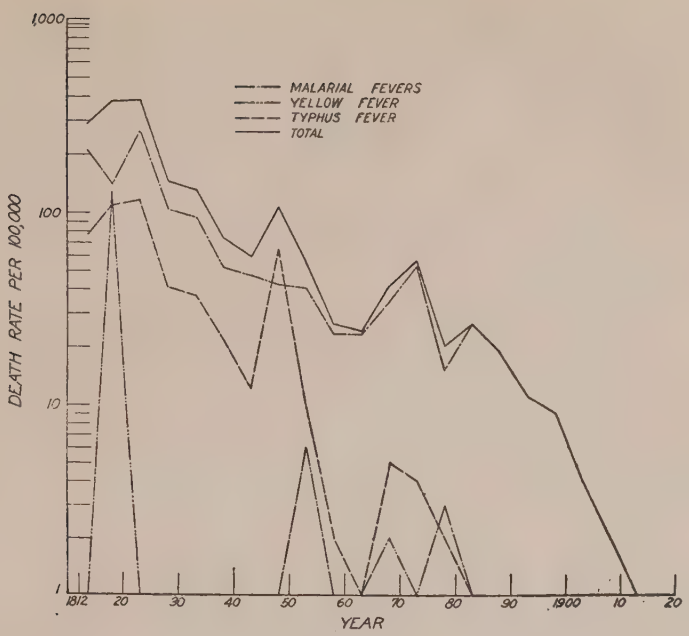
TABLE 18.—*Average rate of death by 5- and 10-year periods from insect-borne diseases, from 1812 to 1920, inclusive.*

Period.	Malarial fever.		Yellow fever.		Malarial and yellow fever.		Typhus fever.		Total.	
	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.
1812-15...	211	....	....	....	211	....	77	....	288	....
1816-20...	141	172	126	70	267	242	109	95	376	337
1821-25...	264	....	1	....	265	....	116	....	381	....
1826-30...	104	184	....	1	104	185	41	78	145	263
1831-35...	95	....	....	....	95	....	37	....	132	....
1836-40...	52	74	....	....	52	74	22	29	74	103
1841-45...	47	....	....	....	47	....	12	....	59	....
1846-50...	42	44	....	....	42	44	64	38	106	83
1851-55...	40	....	6	....	46	....	10	....	55	....
1856-60...	23	32	....	3	23	35	2	6	26	41
1861-65...	23	....	....	....	23	....	1	....	24	....
1866-70...	34	29	2	1	36	30	5	3	41	32
1871-75...	52	....	....	....	52	....	4	....	56	....
1876-80...	15	34	3	1	18	35	2	3	20	38
1881-85...	26	....	....	....	26	....	....	....	26	....
1886-90...	19	22	....	....	19	22	....	....	19	22
1891-95...	11	....	....	....	11	....	....	....	11	....
1896-1900.	9	10	....	....	9	10	....	....	9	10
1901-05...	4	....	....	....	4	....	....	....	4	....
1906-10...	2	3	....	....	2	3	....	....	2	3
1911-15...	1	....	....	....	1	....	....	....	1	....
1916-20...	....	1	....	....	....	1	....	....	....	1

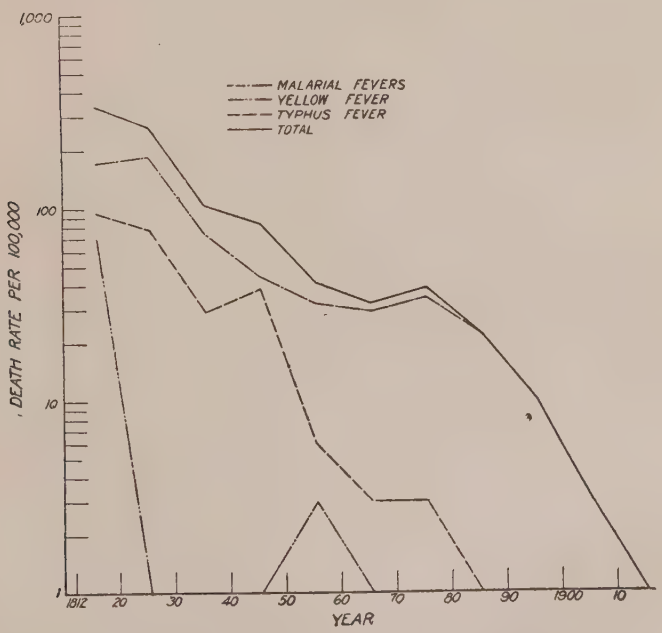
The drop in the rate to 15 in 1876–1880 was succeeded by a rise to 26 in 1881–1885. From this date the rate declined uninterruptedly to the vanishing-point in 1916–1920. When the rates are averaged for 10-year periods (graph 4) the course of the curve is even smoother.

Assuming that the absolute figures for deaths from malaria during these periods are approximately accurate, from the information at hand, how may these high rates and their fluctuations during these two periods be explained?

The first wave of malaria, evidently well on its ascent before the present story opens, comes under observation after a period of rapid growth due to immigration on a huge scale of people from more northern climates and less inured to malarial infection to a crowded little city situated on a stagnant basin, bisected by streams sluggish in the summer, and surrounded by marshes,



GRAPH 3 (from table 18). Crude mortality rates from insect-borne diseases, averaged by 5-year periods, from 1812 to 1920.



GRAPH 4 (from table 18). Crude mortality rates from insect-borne diseases, averaged by 10-year periods, 1812 to 1920.

about which its chief industrial life was centered. For over 20 years previous this community had carried on a thriving commerce with tropical or semi-tropical ports, and this trade was still active and remained so for many years. Thus, malaria in its severest forms must have been constantly imported to be readily spread among a population but poorly acclimated. The lower parts, at least, of the city abounded in stagnant pools and ill-drained streets, yards, and vacant lots. Two reservoirs at the upper borders of the city furnished additional breeding-places for mosquitoes. Cinchona bark, on account of the wars, was probably too scarce and too high in price to be available for a large proportion of the inhabitants.

The minor epidemic peaks of the second wave were perhaps associated with the ultimate killing off and reaccumulation of susceptibles (immigration being largely responsible for the latter) and the neglect after a year or so of sanitary measures inaugurated during the epidemic peaks.

The third great wave, extending over the 15 years between 1862 and 1877, differs radically from its two predecessors. Its ascent is at first gradual and broken by a minor wave without a decided peak covering the last 3 years of the Civil War and then abrupt, reaching its highest level in 1871. From this point there is a gradual drop during the 3-year period, 1872 to 1874. In 1875 there is a marked drop to 14, and the wave culminates in 1877 with the lowest rate hitherto attained. The intermittent type of malarial fever now makes a much more decided contribution to the total rate than before, and its curve follows very closely that of the total curve. The curves of bilious fever and of congestive fever, the two elements representing continued or æstivo-autumnal malarial fever, conform very closely with the curves of the total malarial rate and with the rate for intermittent fever. Indeed, were the rates for these two types combined, the resulting curve would closely fit both as to area and form the curve for intermittent.

The decline in the rate for continued fever and the consequent comparatively low total rate during and immediately after the Civil War are probably directly associated with the cutting off of communications of Baltimore from the Southern States, the West Indies, and Central and South America during this period, and the subsequent rise in the death-rate from this type of malaria in the succeeding years up to 1871 and 1872, may well be intimately associated with the assumption of relations by land and by sea with these sources of more virulent malaria. It will be noted that during the Civil War there was a distinct, though not very great rise in the curve for intermittent fever, with a subsidence before the beginning of its great rise to rates of over 30 during 1871 and 1872. It is evident that the restrictions upon civilian intercourse during the Civil War more than counterbalanced any infection of the city by troops. The rise in the rates for malarial fevers between 1866 and 1874 was perhaps influenced to a considerable degree by the large immigration of unacclimatized people from Ireland and Germany. Among conditions of a local character favoring the fall of malarial deaths were the improvements resulting from the draining and filling at Fell's Point and along lower Jones Falls and Harford Run, the abandonment of the Franklin Street and Belvedere Reservoirs, and the covering over of Chatsworth's and Schröeder's Runs.

The last great wave, beginning in 1878, is characterized by a curve that rises almost abruptly to its highest point with a rate of 28 in 1881 and falls very

gradually with a few minor rises (1893–1896 and 1897–1900), disappearing almost entirely in 1915. This curve is, therefore, relatively smooth. The rate for the newly introduced rubric malaria is the chief contributor to the total rate, and, as previously explained, this term must include deaths from both the intermittent and the continuous types of malarial fever. It will be noted that with the decline of its curve from 1897 and its disappearance from the nosology in 1902 the curve for intermittent fever rises. After 1910, no distinction was made between continued and intermittent fevers. Bilious fever contributes a small quota to the total rate until 1885, and remittent fever is responsible for a considerable contribution thereto until 1897. To what factors is the course of the malarial curve from 1877 to be attributed? The reasons for the rise immediately after this date are as uncertain as are those for its fall immediately before. The rise and the peak of the curve coincide with the beginning and continuation of a migration from southern Europe, i. e., Bohemia and Italy, and from northern Europe, particularly of Polish Jews, the people from both sections, however, probably subject to malaria in their home countries. At this period, too, virulent malaria was frequently introduced at Sparrows Point by ore steamers from Cuba. The city was extending not only to the north, but to the northeast and northwest to higher ground. People also settled in the northeast along the uncovered portion of Harford Run and at the extreme south at Locust Point about docks. Facilities for reaching the lower tidewater counties of Maryland and Virginia for vacations and excursions were greatly increased on account of the development of steamboat lines. On the other hand, the clipper ship had well nigh disappeared, and the southern and tropical shipping trade was greatly curtailed. Thanks to the improvement in paving, grading, and filling, the development of more and better storm-water sewers, the improvement or abandonment of cow stables, the improvement in garbage collection and nuisance control, considerable changes for the better took place in those general conditions which favor the breeding, protection, and distribution of mosquitoes. Overflowing cesspools, somewhat better controlled than formerly, were not gotten rid of until after malaria ceased to be a cause of death in Baltimore. The recent anti-mosquito campaign of the health department came after this date.

Though the physicians of Baltimore in general, and the leading physicians in particular, were well grounded in the various aspects of malaria, and Councilman and Abbott (52) had confirmed Lavaran's studies on the malaria parasite at Bayview Hospital as early as 1885 and had taught the resident physicians of that institution the methods of blood examination as related to the diagnosis and treatment of this disease, it was not until the opening of the medical dispensary and wards of the Johns Hopkins Hospital under Osler, in 1889, that critical routine studies of the different forms of the malarial parasites in relation to the various types of malarial fever were regularly practiced in this city, and a certain looseness in diagnosis, not only between the various forms of this disease, but between them and wound infections, typhoid fever, and other diseases, on the part of the general practitioner began to be rectified. By 1895, the activities of the pupils of Councilman, Abbott, Welch, and Osler, the influence of these teachers, the entry upon the field of consultation practice of Osler, Mitchell, Lockwood, C. B. Gamble jr., Thayer, Simon, and others so reacted upon the other hospitals and upon general medical practice that the

diagnosis of malaria became more rigid and its treatment more exact. An important rôle in correcting the confusion between malaria and typhoid fever and tuberculosis was played after 1900 by the bacteriological laboratory and by the critical attitude of Dr. Jones towards death certificates.

The decrease in malaria and its final disappearance as a serious menace as a cause of death in Baltimore are probably due (1) to breakdown in the trade communications with localities in which malaria in severe types is endemic; (2) to the very gradual improvement in drainage, due to filling, grading, the building of storm-water sewers, and the covering of the three streams and the straightening and narrowing of the bed of the fourth, Jones Falls; (3) to the gradually increasing use of cinchona bark and its preparations, both in treatment and in prevention. It has been shown that malaria had almost entirely disappeared before the institution of the organized anti-mosquito campaign in 1910.

Of the above measures, undoubtedly the most important was the freer use of quinine during the last 50 years, not only in the treatment of recognized malaria and as a preventative, but as a tonic, either alone or with other drugs in the treatment of all sorts of ailments. In the course of time, a large proportion of the population was saturated with quinine. During much of the time when malaria was at its worst, cinchona bark and its derivatives were scarce and so high priced as to be out of the reach of a large part of the population. Changes in the plan of treatment of severe malaria, according to which cinchona bark and its preparations were given earlier and in larger doses, and particularly by the hypodermic method, without waiting for results from the bleedings, emetics, purgings, and blisterings, as was formerly the custom, must have materially lowered the mortality.

YELLOW FEVER.

In Chapter V, in tracing the important part yellow fever played in determining the policies of public-health administration in Baltimore, and particularly in regard to quarantine measures, some account has been given of the distribution of the disease in Baltimore and of the views held in regard to its origin and mode of spread, and this need not be repeated in detail here.

Certain cardinal facts stand out clearly, namely, that (1) yellow fever in epidemic form in Baltimore nearly always began at Fell's Point, the docking-place of ocean-going vessels; (2) it always remained limited to that area, except under the influence of unusually strong winds blowing over the district primarily infected towards the section secondarily affected; (3) when cases of yellow fever were removed from the primarily infected district to high ground (in the country or at the hospital at Broadway and Monument Streets), secondary cases did not occur; and (4) when residents of West Baltimore, who had contracted the disease while working in or visiting the infected area at Fell's Point, remained in their homes and when cases of yellow fever were imported from Fell's Point into West Baltimore (1797, 1855, 1883, and 1899), there were no recognized secondary cases.

In the discussion of malaria it has been shown that conditions favorable to mosquito-breeding, while particularly favorable at Fell's Point, must have existed throughout at least most of the city. That the *Anopheles* mosquito bred very widely in Baltimore is clear from the known distribution of cases of

malaria. From the evidence at hand it would seem clearly established that the *Stegomyia* mosquito was at least in most years limited to Fell's Point and the Lazaretto Point and their immediate environs. Perhaps this species of mosquito rarely, if ever, survived the Baltimore winter, and, having to be imported each year and arriving late in the season, it did not have opportunity for wide spreading from the region of the docks (Lazaretto and Fell's Point) at which it landed.

The recorded data as to reported cases and deaths of recognized yellow fever at the quarantine stations have been presented in the chapter relating to quarantine. The mortality within the city is presented in table 17 and graph 2.

It is very improbable that, with the large shipping trade between Baltimore and the West Indies and Charleston and Savannah, not to mention other places where yellow fever was indigenous or often epidemic, the disease appeared here for the first time in 1794. While this year certainly marks the first great epidemic of this disease recognized as such in Baltimore, it is extremely probable that not infrequently before this date from a few to a considerable number of cases must have occurred and have been mistaken for bilious remittent malarial fever in both mild and severe forms. Indeed, Davidge, one of the first in North America to recognize that yellow fever is not contagious, held that it was only a heightened form of malarial fever, a view shared by many of his colleagues; and, as a matter of fact, in those of the early epidemics which are recorded in fullest detail, the first cases were invariably believed to be bilious remittent fever, and it was only after much investigation, discussion, and consideration that the existence of yellow fever was established and officially acknowledged. In a community in which some of the leading physicians were honestly convinced of the fundamental identity of two affections with such a large proportion of their cardinal symptoms in common, it was not to be expected that the authorities would lightly declare that cases of the annual summer visitation of continued fever belonged to the category *yellow,* and thus advertise the presence of a malady to a prejudiced world, which, in its ignorance, classed it as a contagious pestilence, thereby, simply because of the use of a mere name or label, which in reality signified an error, bringing all the disadvantages and losses entailed by a quarantine upon a seaport whose prosperity depended upon a free and untrammeled commerce. This being the attitude towards yellow fever and its recognition as a separate disease after two considerable epidemics within 4 years (1794–1797), it is extremely unlikely that, in the loosely organized administration of Baltimore Town before the scare of 1793, any great pains were exercised by either physicians or authorities to discriminate between yellow and bilious fever at Fell's Point, where illness and death of continued fever were common each year.

The doctrine of the local origin of yellow fever and the failure to recognize that it was commonly imported on ships were not peculiar to Baltimore in the latter part of the eighteenth and the early years of the nineteenth centuries; the same errors were made in Philadelphia and in Charleston, South Carolina. Notwithstanding these opinions, the Baltimore city council quarantined against Philadelphia in 1797 and again in 1800, when yellow fever broke out there before its presence was recognized in Baltimore.

Owing to lack of data in regard to the number of deaths annually ascribed to malarial fevers prior to 1812, comparative studies of the death-rates of

malarial and yellow fevers in Baltimore can not be made for any year prior to 1819, the first subsequent year with recorded deaths from yellow fever.

The rather meager information in regard to 1794 is drawn from the accounts of Quinan and Cordell, both of whom wrote many years later. The governor's quarantine officers and the local board of health were publicly criticized as early as July 8 for permitting yellow fever to gain entrance, but it was not until August 13 that Drs. Coulter, Brown, and Goodwin reported malignant bilious fever at Fell's Point, to which location the disease was apparently confined. The board of health reported the city free of the disease on October 1 and admitted only 344 deaths from all causes in August and September. Cordell gives the number of deaths due to yellow fever alone for this year as 360. There is no record of the total number of cases. If the actual fatalities from yellow fever were 360, and if it is true that the disease was confined to Fell's Point, where the total number of inhabitants could not have far exceeded 2,500, the attack and the death-rates were appalling, and the death-rate of 2,400, calculated on the estimated population of the whole town, high as it is, gives but a very incomplete idea of the severity of the scourge.

Concerning the yellow fever epidemic of 1797, there exist two accounts which supplement each other, the report of the commissioners of health to the mayor and city council (53), published in the *New York Medical Repository* for November, 1797, and the essay of John B. Davidge (33), published the following year.

The commissioners organized as a board of health on June 5 and soon afterwards enforced the new quarantine act on shipping from the West Indies and took precautions to examine travelers from Philadelphia, when later in the season a "malignant fever" appeared there.

During July and August the health of the citizens of West Baltimore was unusually good; many nuisances had been removed, some low places had been filled, and the streets were cleaner than usual. In East Baltimore (Fell's Point) a "bilious complaint" regarded as the common sickness of the season commenced early and gradually progressed to a worse stage. On August 26, in response to letters from the board, Drs. Coulter, Allender, and Joquit, of Fell's Point, while confessing to the presence of a severe type of continued fever, replied to the effect that they did not regard it as departing from the usual bilious remittent and intermittent, and cited their experiences as evidence that the fatality was not high. According to Dr. Coulter, on the fourth or fifth day, if timely remedies had not been applied, vomiting of black matter like coffee-grounds and sometimes mixed with dark blood occurred, attended with profuse hemorrhages from the nose, gums, and intestines, which generally carried the victim off on the sixth day. Since June he had attended upwards of 300 such cases and had lost only 8. At a meeting of the physicians of the city called on August 28, after the reading of these letters in reply to the questions of the president of the board of health, they all denied having knowledge of the existence of any contagious or yellow fever, except Dr. Davidge's case of a lady lately returned from Philadelphia (previously narrated elsewhere) and a suspicious case attended by Dr. Smith. The next day, Drs. Goodwin, Moores, and Davidge, who investigated the cases of fever at Fell's Point, reported that they "discovered nothing like a malignant, contagious, or yellow fever; the

patients whom we saw all labored under the common bilious remittent, and will generally recover, with common attention."

On September 3, five members of the board, with Dr. Moores as medical adviser, investigated conditions at Fell's Point, and though they found that there had occurred a considerable extension of the disease, especially among the poor, they were not convinced, officially at least, that the malady was yellow fever. The next week, some days after the gathering of a crowd of people from all parts of the city to witness the launching of a frigate at Fell's Point, there was a considerable extension of the disease in that district and the appearance of several cases in West Baltimore. On September 8, the first case of yellow fever was officially reported by Dr. Moores. According to Davidge, the most prominent advocate of the identity of bilious remittent and yellow fever, "a little later, the disease raised from the grade of bilious to yellow fever and mounted its chariot of death and drove furiously through the streets .... and, conveyed by the northeast wind, it scattered itself all along Federal Hill and the west end of the basin; whichever direction the miasmata (arising from the stagnant water along the marshes and wharves), controlled by the winds, took, the disease tread closely upon its footsteps." It sped to the end of Hanover Street and its vicinity and in a short time it penetrated "to the vitals of the city and affected many who were not near the point or the wharves." Potter gives the date of the great wind as September 17 and its direction as from the southeast, blowing the "pestilential effluvia northwesterly and spreading the fever along Frederick, Gay, South, and Calvert Streets. Since it was found unpracticable to transport the sick to the quarantine hospital at Hawkins' Point, a private house near Fell's Point was converted into a hospital, capable of accommodating but a small proportion of the sick poor. At a meeting of the board of health with the physicians on September 11, the latter advised against the removal of the inhabitants of Fell's Point to the country and the cutting off of communication between Fell's Point and the rest of the city.

In the report of the board of health, the actual number of cases and deaths of yellow fever is not given, but from the following figures for the total deaths for almost equal periods before and during the epidemic some estimate of its ravages may be obtained: Deaths from all causes, August 1 to September 11 (42 days), adults 97, children 74, total 171; September 11 to October 29 (48 days), adults 408, children 137, total 545. According to Davidge, the greatest number of deaths in the west end, or city proper, in any one day was 8, while the list of deaths at the point was for some time considerable. The epidemic began to subside about October 1 and was nearly or quite extinct by November 1. Of the inhabitants of Fell's Point, 2,679 remained throughout the epidemic and 671 removed.

From the meager accounts extant, it seems probable that yellow fever existed at Fell's Point in 1798 and certainly was present in 1799, but definite records of the number of cases and deaths are lacking.

According to the report of the Medical Faculty to the mayor on the origin of the pestilence in 1800, the disease was of domestic origin and not related to shipping, having started at Fell's Point in May, and its principal source was the cove extending from the mouth of Jones Falls to the interior of Fell's Point. Potter records that the increment of cases could be calculated with tolerable

accuracy by observing the variations of the winds. Though no record is available of the actual number of cases and deaths, the epidemic was of considerable extent, for on August 28, the day the disease was acknowledged to be yellow fever, the board of health arranged to have the cases reported to it daily by special messengers. On September 2 a special encampment was established for the poor who wished to flee from the disease, and on the 5th, cases were reported in West Baltimore. The epidemic ceased October 22. The total deaths for the year were given as 1,197, or a rate for all causes of 45.

Cases of yellow fever were recognized at Fell's Point in 1802, but according to the scanty accounts not in epidemic form.

The sole authority found for the existence of yellow fever in 1807 is Potter, who records it as of special interest, to prove the local origin of the disease, since it occurred during the period of the embargo, when not a foreign ship entered the port. He quoted Drs. Allender and Clendenin, who had experienced the former epidemic at Fell's Point as attesting to the true character of the fever.

Concerning the epidemic of 1819, the greatest since 1794, and the last one of serious dimension, there is considerable literature. Reese's pamphlet (25) is especially clear and full. The first two cases occurred on July 21 and 22 in two men who frequented Smith's Dock at the point. At this dock were two schooners, recently from the West Indies, laden with coffee and hides. After the outbreak of these two cases, the vessels were sent back to the quarantine grounds, but as the health officer found the crew healthy and the cargoes in good condition, they were allowed to return to dock. Soon afterwards, 5 other cases of yellow fever occurred in men working on Smith's Dock. The outbreak was attributed to the foul condition of Smith's Dock and the Frederick and Gay Street Docks, to the general insanitary condition of Fell's Point, and to two stagnant ponds between the point and the lazaretto. The disease afterwards broke out at the latter place. By August 14, cases were apprehended at the lower east end of Fell's Point, at least a mile from Smith's Dock. By August 28, about 50 cases had been reported, and the deaths were said to be about one-fifth the number attacked. Under the influence of a strong southeast wind, the disease was rapidly spreading towards Jones Falls and the city to the west of it, when, after veering, the wind blew for some days with equal force from the northwest, and the disease ceased to spread in that direction. Many persons, certainly over half of the population, fled from Fell's Point, some to the country and others to the city proper. Many cases were sent to the new Maryland Hospital on Broadway. There were 1,010 cases reported, but Reese estimated the total number of cases at 1,200. The official report placed the deaths at 350.

Four deaths were credited to yellow fever in 1821, but the number of cases was not recorded. In 1853 there was a sudden outbreak of 18 cases of what was recorded as yellow fever, all fatal and occurring within a single block of dwellings at Fell's Point. The origin of the disease was not traced. "About 50 cases," one-half of which are said to have proved fatal, are recorded in the annual report of the board of health for 1854 as occurring at Fell's Point, in the same locality as in the previous year. The disease was regarded as of local origin. The deaths (13), from yellow fever occurring within the city during 1855 were all among refugees admitted from Norfolk, Gosport, or Portsmouth, at the entrance of the Bay. No secondary cases developed from these.

Early in the summer of 1859, a vessel from the West Indies was allowed to pass quarantine on account of her bill of health, and 5 laborers, who had been engaged in unloading her, developed typical yellow fever. Though they were nursed in their homes, the disease did not spread. A month after the departure of the vessel a pernicious fever, attended in some cases with black vomit, appeared on Fell's Point, and in several cases it proved fatal. In 1869 there were 27 deaths from yellow fever at Fell's Point. The 71 cases with 59 deaths (44 of the latter within the city and 15 at the quarantine hospital) in 1876 were recorded as typho-malarial fever by the commissioner of health. Dr. W. T. Councilman, in a personal communication, is the authority for the statement that Dr. E. Lloyd Howard, the quarantine physician, who attended many of them, regarded the disease as certainly yellow fever. According to the report of the commissioner of health, the cases occurred in rapid succession on Caroline Street near Thames Street, opposite to the City Dock. The illness was very acute, death often taking place within 24 hours. Of the 46 cases not removed to the quarantine hospital, only 2 recovered. The disease did not spread beyond this immediate locality. The few cases recorded in 1883 and 1899 developed in sailors taken sick on ships at the docks after passing quarantine; no secondary cases occurred.

In the 49 years between 1850 and 1899, cases of yellow fever were recognized at the quarantine station on ships in 23 years and the disease appeared in the city in at least 8 of these years. In only 2 of these 8 years, 1854 and 1883, was the disease not recorded as present on ships inspected at quarantine. As a matter of fact, during the earlier years of this period, as well as during the 30 years between 1821 and 1850, when no cases and no deaths of yellow fever were recorded in the city, it is extremely probable that yellow fever often got into the city and either was not recognized, or, if recognized, its presence was not recorded by the officials. Considering the extensive commerce with yellow-fever infected places and the looseness of the quarantine administration of a city committed to the doctrine that yellow fever was of local origin, it would be preposterous to conclude that yellow fever completely failed to gain access to Baltimore between 1822 and 1853.

During this period, "bilious remittent" fever was expected to recur at Fell's Point widely spread and in deadly form each summer and fall, and what was more likely and consistent than that the cases of yellow fever occurring at the same time should be reckoned as belonging to the former category. The remarkably high death-rates attributed to bilious fever during this period would seem to demand this assumption for their explanation.

The failure of the disease to spread among the inhabitants of the city in 1855, when there were 13 deaths among refugees from Norfolk, Portsmouth, and Gosport, is not remarkable in the light of the occurrences of other years. It is likely that these refugees belonged exclusively to the type of people who would have received shelter on the west side of the city on high ground, rather than at Fell's Point.

From the résumé given of the history of malaria and yellow fever in Baltimore, it is evident that in the late years of the eighteenth and in the earlier years of the nineteenth centuries, these two mosquito-borne diseases were very much confused. It is certain that in the epidemic of 1819 many of the earlier deaths at least were attributed to bilious fever and that for this year the official

figures for deaths from yellow fever were lower than actually experienced. It is certain that, owing either to mistakes in diagnosis or to wilful intent to hide the truth, in other years after 1819 a considerable number of deaths from yellow fever were ascribed to bilious fever. Indeed, in 1853 and 1854, while descriptions of outbreaks of yellow fever, with the number of deaths, are given in the text of the annual reports, this disease did not appear in the official mortality tables. For these two years it has been assumed that the deaths from yellow fever were credited to bilious fever, and the figures in the tables have been corrected accordingly. A similar correction has been made for 1876, when 44 deaths from what the quarantine physician who was well acquainted with the disease called yellow fever were attributed to typho-malaria by the commissioner of health. While the official figures for deaths credited to malaria and yellow fever individually can not be accepted as accurate, the sum of the deaths for the two must reflect with a fair degree of accuracy the total fatality from the mosquito-borne diseases.

The averaged rates for 5-year and 10-year periods for total malaria and for yellow fever taken together are given in table 18. From 1812 to 1825, these affections were responsible for an average annual death-rate of nearly 250. By 1826–1830 the rate had fallen to 104 and by 1831–1835 to 95. High rates for bilious fever ended in 1836 (table 17) and it is probable that the period of frequent importation of severe tropical malaria and of yellow fever ended about this time. It is significant that bilious fever is described as being most prevalent and fatal at Fell's Point, the only place where yellow fever flourished. The combined rate fell continuously until 1846–1850 to 42. During the next 5 years, synchronously with three recorded slight outbreaks of yellow fever, the rate rose to 46. Falling to 23 in 1856–1860, and remaining stationary during the next 5 years in connection with known but small outbreaks of yellow fever, the rate rose between 1865 and 1875 to 52. The rise in the rate in 1881–1885, after a fall to 18 in 1875–1880, was perhaps associated to some degree with unrecognized yellow fever. It is doubtful if yellow fever was responsible for any considerable number of deaths after 1876. With the annual rates averaged for 10-year periods, except for a slight reaction for the decennium ending in 1880, the course of the curve from 1812 to 1920 is continuously downwards.

TYPHUS FEVER.

The local chroniclers record no serious epidemic of typhus fever during the eighteenth century, and its early history in Baltimore is shrouded in mystery. According to Jameson, it was present in 1799 and 1800. Typhus and typhus mitior are mentioned in the reports of the censors of the Medical and Chirurgical Faculty as among the diseases prevalent in 1809, 1810, and 1811, but not as serious epidemics. Typhus fever is so rarely alluded to before 1852 in the annual reports of the health department that, but for its appearance in the list of interments as a considerable cause of death, its existence as a public-health problem would not be suspected.

The sudden outbreak of typhus fever in 1814, with 56 deaths, as compared with none in 1812 and only 1 in 1813, may have been due to its spread from local endemic foci of mild type to the American troops defending the city, to

importation from other American cities—New York or Philadelphia for instance—or, on the other hand, to contact on the part of civilians or troops with the British forces operating in Maryland. On account of the effective blockade of the whole Chesapeake Bay by the British fleet, the disease could hardly have been imported directly from Europe to Baltimore by vessels of commerce in this year. However this may be, as may be seen from table 17, graph 2, there began in 1814 an epidemic of great intensity, which extended over a period of 15 years, and no year was without fatalities from this cause until 1860.

The course of the disease during the 15 years between 1813 and 1828, as evidenced by the death-rates, was that of a great epidemic wave of a virulent disease, in which the death-rate was for 13 consecutive years over 50 and which was broken by three very high subsidiary waves. The first of these coincides with the war with Great Britain, and the second and third with the period of great financial depression and want that occurred in Baltimore and elsewhere following the Napoleonic Wars, during which typhus fever was particularly prevalent and virulent in Europe. It is likely that the beginning of this great wave was connected with the introduction of the disease from contact with the British expeditionary forces, and that its continuation after peace in 1815 was due to constant reimportations upon the resumption of commerce and immigration with Europe, particularly with Ireland and the ports of Liverpool, Glasgow, London, and Bremen. During this period the contribution of typhus fever to the general death-rate was a heavy one.

The next wave, beginning in 1829 and reaching its highest point in 1832 with a death-rate of 59, was associated with the crowds of immigrants, asserted by the quarantine officer in 1831 to be composed largely of the lame, halt, blind, and poverty-stricken, brought in by vessels in ballast from Europe, their passage often paid by the parishes from which they came.

By 1840, typhus fever in Baltimore had become stabilized at a comparatively low rate and remained so until the definite epidemic of 1847–1851, which was clearly associated with the great immigration in those years from famine and typhus stricken Ireland. In 1847, 101 cases of typhus, of whom 17 died, were removed from ships at quarantine; and, as late as 1852, 48 cases were removed from a single ship, and of 144 of her passengers held at the lazaretto for observation, 80 developed the disease. From the frequently quoted work of Buckler, it would appear that in this epidemic the chief incidence of the disease was among the recently landed immigrants and the free blacks. Among the former, some were sent directly from ships to the almshouse, and many after they had dwelt as servants in private families for one or two weeks after landing. In May and June of 1849 there was an epidemic of typhus confined almost exclusively to free negroes. "In rows of houses occupied by Germans, Irish, and free blacks, it would invariably single out the latter, in many instances seizing an entire family." Of 83 cases, all blacks with one exception, sent to the almshouse infirmary, ranging in age from 5 to 75 years, 39 were fatal.

"The cases were far more fatal in the beginning than at the close of the epidemic; of the first 18 cases admitted, all died, and of the last 20, all recovered. The mystery is why the blacks alone should have suffered. The cases came from Strawberry Alley on the east, Run Alley on the west, Biddle Alley on the north, and intermediate points. L Alley, near the center of the city and directly back of the public stores, was entirely depopulated."

The greater incidence of the disease among the free than among the slave negroes is probably explainable in two ways—the greater number of the former in the population (over 8 times) and their greater exposure and comparative undernourishment. The slaves were better housed on their masters' premises and were well fed, while the free negroes, relatively underfed, lived largely in alleys in closer contact with the poorer immigrant whites. The greater susceptibility to the disease of the negro than the poor white was probably due to the fact that he was new to it and that many were heavily infested with lice.

Buckler pointed out that the quarantine system, as conducted, had never kept out the disease and that the policy of the city government towards the disease within the city was hopelessly ineffectual.

Between 1856, when the disease had again become stabilized at a low rate, and 1869, cases were encountered at the quarantine station in only 3 years, 1857, 1858, and 1866.

There were flareups of the disease in 1866–1867, 1870–1871, and in 1875, and the first two of these coincided with European wars. In 1870, 282 cases of typhus were removed from ships at quarantine, and in each of the 3 succeeding years cases were similarly detected.

Between 1875 and 1892, cases were apprehended at quarantine in only 3 years, 1878, 1887, and 1892. Only 2 deaths were recorded in the city between 1884 and 1918. The salient features of the course of typhus fever are well brought out in the annual mortality rates averaged for 5- and 10-year periods (table 18, graphs 3 and 4). From the curves three epidemic waves stand out distinctly. Following the curve of the rates averaged for 5-year periods, the first wave, beginning with a rate of 77 for 1812–1815, rose to a peak with a rate of 116 in 1821–1825, and then declined continuously to the low level of 12 in 1841–1845. The second wave reached its sharp peak in 1846–1850 with a rate of 64 and fell abruptly to its low ebb in 1861–1865. The third wave, with its flattened peak, marked by rates of 5 in 1866–1870 and of 4 in 1871–1875, had subsided by 1876–1880. From 1880 there was no significant number of deaths.

Typhus fever may be said to have run its course in Baltimore, certainly between 1813 and 1895, without any interference worthy of the name by the health department, either by keeping the diseases from gaining entrance through the port or by restrictive measures applied within the city. No serious efforts were made even to secure the reporting of cases, and when cases came to the knowledge of the health department, no adequate measures were taken to prevent the spread of the disease. Hospitalization was attempted in the cases of only some of those who were in such dire want and affliction that they could not be taken care of in their dwellings, and these were placed in the public wards of general hospitals without any precautions. The gradual disappearance of the disease was due entirely to causes unconnected with local public-health administration.

No distinction was made between typhus or typhus gravior and typhus mitior, and typhoid fever did not enter into the local statistical nosology until 1851; therefore the question as to the confusion of typhus and typhoid fevers in the tables of causes of death naturally arises. This question will be considered in detail under the discussion of the latter disease; suffice it here to state that there must have been some confusion on this point, certainly in the earlier

years, that the rates for typhus fever as given are on this account too high, but that, on the whole, it is probable that the errors connected with typhoid fever affected the rates for continued malarial fever to a much greater degree than those for typhus fever. If typhoid fever was very prevalent and deaths from it were classified under typhus fever to any great extent, the death-rates for the latter could hardly have been so low as they were between 1833 and 1845, before typhoid fever was recognized in the statistical nosology, or between 1851 and 1869, after this event.

SUMMARY.

The course of mortality for this group of diseases as a whole is best studied by comparing the rates as averaged for 5-year periods (table 18, graph 3). From an average rate of 288 for the period ending in 1815, the rates ascended to 376 in 1816–1820 and 381 in 1821–1825. For the 10 years between 1816–1825 the annual death toll from these diseases was then not far short of 400, and during this time each member of the group reached the highest level attained during the period under review. In the 5 years ending in 1830, the picture completely changed, and, due to decreases in the rates for each separate disease, the total rate sank to 145. With the continued absence of yellow fever, at least as a recorded cause of death, and striking declines in the rates for both malaria and typhus fever, the total rate continued to fall and by 1841–1845 it had reached the comparatively low level of 59. Owing to a recrudescence of typhus fever and in the face of an actual fall in the rate for malaria, the total rate rose to 106 for the 5 years ending in 1850. During the next 5 years, in spite of a return of yellow fever, the total rate fell by 50 per cent. Between 1855 and 1865 the average rate was about 25. Associated with a rise in the rates of all three members of the group, the total rate ascended to 41 for the succeeding 5 years, and for the 5 years ending in 1875 it averaged 56. In spite of a slight turn of yellow fever, the total rate for 1876–1880 averaged only 20. Due to a rise in the rate for malaria, the total rate rose to 26 during the following five years. After 1885 the rate, with malaria now its sole contributor, fell gradually to a negligible value in 1920. Typhus fever, responsible for a large toll of deaths during the early part of the century, ran its course in epidemic waves. The first was the longest and most severe. The last two were comparatively mild, and each was less severe than its predecessor. In each epidemic the disease pursued its way uninterfered with by restrictive measures. Cases were not reported routinely, isolation and disinfection were not practiced, and hospitalization was confined to the homeless and the very poor, who were placed indiscriminately in the general wards. It may be said, then, that the course of typhus fever in Baltimore, until very recent years, represented the untrammeled reaction of the disease upon the population. Though recurring with a few scattered cases repeatedly from time to time since the last epidemic, the disease, in recognized form, has never gained a foothold, nevertheless, as has been shown by the inspection of school children as late as 1915, a considerable proportion of the population in various sections of the city was infested with head lice.

In previous chapters it has been made clear enough that active administrative measures were directed against nuisances of the type which favored the recurrence and spread of malarial and yellow fevers. The correctness of their

view that these diseases were not contagious in the usual sense and their erroneous belief that yellow fever was of local origin, and that both arose from miasmata generated in stagnant water, combined to lead the authorities on the right track in their efforts to combat them by sanitary measures. They pursued their policy of securing dry cellars, of filling and draining low places, of putting in drains, and of straightening and covering streams as best they might, just as determinately and as rapidly, under the influence of the old miasma theory, as they would have on the basis of correct information. So far as the city was concerned, the difficulty lay in the fact that the problems presented by rapidly expanding ocean commerce with infected localities, exuberant population growth, and the topographical conditions were too great to be rapidly overcome with the means at hand. Lack of knowledge concerning the relation of mosquitoes to the propagation of these diseases was, of course, a serious handicap that militated against their efforts in many respects. The closed or almost closed docks at Fell's Point and the extensive marshes on each side and the pools of stagnant water on the point itself furnished ample breeding-places for myriads of mosquitoes. Lazaretto Point, just southeast of Fell's Point, where until 1836 ships and cargoes were inspected, aired, and cleansed and passengers and crews were detained, was nearly surrounded by marshes and ponds. Thus conditions were ideal for the perennial propagation of malaria in both its milder indigenous and its severer imported forms and of yellow fever when imported from the tropics and from the southern parts of the United States. It is probable that the great drop in mortality from the mosquito-borne diseases between 1825 and 1830 was due in large measure to sanitary improvements at Fell's Point and about Lazaretto Point, and that the further fall between 1835 and 1845 was to a considerable degree the result of the destruction by fire in 1836, of the Government lazaretto with the consequent abandonment of this place as an inspection-point for ocean shipping. With the permanent establishment of quarantine inspection and detention at Fairfield Point and later at Leading Point, as isolated, though mosquito-infested localities situated further from the city, the chances of importing pernicious malaria and yellow fever at the Fell's Point and other city docks must have been materially diminished, though, as the records show, by no means closed.

That part of the city called Old Town, along the east side of Jones Falls, and the territory of the city proper, situated along the west side of Jones Falls and the basin, were in the early days second only to Fell's Point as centers of malaria. By the end of the first quarter of the nineteenth century considerable improvements had been accomplished in these localities also as the result of straightening the course of the falls, filling in the marshes and other low grounds, and grading and paving streets and laying gutters. Activities of this character, together with improvements in the banks and channels of the lower reaches of Harford, Schroeder's and Rutter's Runs and of Jones Falls were prosecuted with vigor during the next 25 years. While these measures were never pushed to a state of completeness that entirely removed the conditions essential to mosquito-breeding in the growing city, they were probably in large part responsible for the fall in mortality from the mosquito-borne diseases between 1835 and 1860. The slight reaction in the rate between 1850

and 1855 was associated with the repeated importation of yellow fever. The stationary state of the rate during the Civil War period, when commerce with the West Indies, Central and South America, and the Confederate States was cut off, suggests that the interference with the importation of malaria from these sources was more than offset by spread to the general population of malaria imported by Federal soldiers invalided from the armies fighting in the Southern States.

The decided increase in mortality from malarial fever during the 10 years subsequent to the Civil War was probably a direct reflection of the resumption of communications with malarious countries and the returning soldiers, combined with relaxation in the progress of sanitary measures connected with drainage and the extensive ditching operations involved in the extension of water-mains at this time. That malarial fever of severe grade was common at this time in the newly built-up territory bordering the stagnant Harford Run is a matter of record. There is convincing evidence that the rise in the rates for malaria between 1885 and 1890 was associated with infection of workers at the steel works at Sparrows Point, where the disease in severe form was constantly imported on ore-carrying vessels from Cuban ports. Between 1875 and 1890 all the large sewer streams except Jones Falls and the numerous uncovered sewers were covered over, and an increasingly large proportion of the inhabitants dwelt upon high ground. Between 1890 and 1920 the whole physical surface of most of the city was gradually changed by sanitary improvements which decreased the amount of standing water. However, in ravines, in cans and other receptacles on ash dumps, and on the irregular surfaces of ill-paved alleys, as late as 1920, there still remained opportunities for mosquito-breeding. The ditching involved in the construction of the new sewerage system between 1906 and 1915 gave ample opportunity for mosquito-breeding. Nevertheless, during this whole period since 1890 the death-rates from malaria continued to fall and before the special campaign to exterminate the mosquito was instituted in 1910 they had reached negligible proportions.

These efforts continuously, though often but slowly and inffectually, put forth by the city authorities to prevent and abate nuisances of the type that favor the spread of the mosquito-borne diseases within the city were not the sole agencies at work. It has been pointed out that the opportunities for the direct importation into the city of malaria and yellow-fever cases and of mosquitoes infected with their causal agents were materially lessened by the removal of the quarantine station to more distant points after 1836, though until very recent years the quarantine never offered a complete barrier. Though the decrease in the rate for yellow fever since 1876 must be credited in great degree to the sanitary improvements and to greater efficacy of quarantine measures, in large degree it must have been due to diminished prevalence of the disease at ports of trade and to the falling-off of shipping. The same considerations must apply also in large part to malaria. Especially important in connection with the fall in the rates from the latter disease has been its decrease in prevalence and severity in tidewater Maryland and Virginia, where it was in former years so frequently contracted by visitors from the city and whence it was constantly imported by visitors from the rural districts. All

the considerable evidence at hand indicates that, significant as were the beneficial results of administrative efforts of various kinds, the chief cause of the decline in the mortality from malarial fever was the saturation of the population with cinchona bark and its derivatives.

ACUTE INFLAMMATORY AFFECTIONS OF THE INTESTINAL TRACT CHARACTERIZED BY FREQUENT LOOSE STOOLS OF ABNORMAL COMPOSITION.

The term "inflammation" is here used in a very wide sense to embrace processes characterized by exudates composed largely of serum or plasma and poor in corpuscular elements, and associated with little or even no apparent loss of intestinal mucosa, as well as processes ranging from sero- and mucopurulent exudations and desquamative lesions to the more severe inflammatory lesions with abundant cellular exudations, hemorrhages, fibrous false membranes, and proliferation and necrosis of tissue.

The affections now to be considered have long been recognized in both medical and statistical nosology as having one conspicuous symptom in common—evacuations from the intestinal tract abnormal in frequency, amount, and composition. The same affection has gone under various names at different periods, as cholera morbus, cramp colic, and diarrhœa, for instance; and a single term, as dysentery, has included several affections varying both in anatomical lesions and in etiology. Affections apparently closely akin in causation and in other relationships as well have been classified separately according to the age of the victims, as cholera infantum for diarrhœa in infants and diarrhœa or one of its synonyms for similar disease in those over 2 years of age. Two members of this statistical group, typhoid fever and Asiatic cholera, stand out clearly both anatomically and causally as definite specific diseases; but even these have been subject to much confusion with other numbers of the group. On the contrary, dysentery, distinguished in its common clinical form by characteristic pain in the lower bowel and by the frequent passage of stools containing mucus, pus, and recognizable blood, is not a single anatomical and etiological entity. The amœbic or so-called tropical dysentery due to *Amœba histolytica* and met with at one period in Baltimore, has peculiar necrotic lesions resulting in typical ulcers in the rectum and colon; but it is by no means always acute and is not invariably accompanied with the characteristic rectal tenesmus and the purulent and bloody stools of the typical clinical dysentery. In fact, this form of dysentery often takes a chronic course, with alternate constipation and diarrhœa, and with stools resembling more closely those of an ordinary diarrhœa than those of typical dysentery. The type of clinical dysentery more common in temperate climates, and recognized since 1897 as caused by the bacillus of Shiga and its several varieties, and now known as bacillary dysentery, has no characteristic anatomical lesion of the intestine. The lesions vary in individual cases from simple congestion of the intestinal mucosa and its lymph follicles to destruction, with ulceration of both, with or without the deposit of fibrinous false-membranes. As will be pointed out in greater detail later, a not inconsiderable proportion of the deaths of infants classified under cholera infantum or summer complaint in

Baltimore in recent years have been due to infection with *B. dysenteriæ,* with consequent confusion of statistical data. A type of dysentery well known to pathological anatomists as croupous or false-membranous dysentery and occurring often, but by no means always, as a complication of other diseases, is probably not always of specific etiology, but caused by a variety of bacteria, notably *streptococcus.* Similar lesions of the rectum and colon occur in mercurial poisoning.

Under this section may be traced a fourth statistical rubric, which for lack of a better term will be called diarrhœa. Here are placed deaths classified under cholera morbus, cramp colic, diarrhœa, inflammation of the bowels, cholera infantum, and teething. According to the best available evidence, drawn from the traditions of local medical and statistical nosology, the last two embrace the deaths now classified under 104 of the present international classification of causes of death—diarrhœa in persons under 2 years of age. For convenience this last group will be given the title in common usage in Baltimore, cholera infantum. The other four headings, at different periods in the history of the health department varying in relative importance in the statistical nosology, represent the present rubric 105, or diarrhœa in persons over 2 years of age. As cholera morbus until 1821 carried most of the deaths for both of these rubrics, the latter can not be separated with any degree of accuracy before this date. As a matter of fact, there is serious reason for doubting that classification between these two divisions of the diarrhœal affections ever approached accuracy.

In this heterogenous group of affections called diarrhœa, the structural lesions of the intestines present, in general, no characteristic features, and are often insignificantly slight in proportion to the severity of the clinical symptoms. Hypersection of mucus, exudation of plasma in large amounts from the vessels, changes in the bacterial flora of the intestines, with excessive fermentation and putrefaction and consequent changes in the character, consistency, and frequency of the stools, and general prostration, often with rapid loss in weight, are the prominent characteristics. In severe cases the picture is strikingly similar to that of cholera, with which considerable confusion has existed at times.

These diseases have in common a second important characteristic, viz, their causes appear to be spread, chiefly at least, in the same way by means of foods acting as vehicles of transmission. They constitute, therefore, the second division of the nuisance diseases. In certain foods recognized as particularly good vehicles, water, milk, etc., the causes of some of these diseases frequently find opportunities favorable not only for prolonging existence, but for multiplying rapidly. As the causal agents are given off from the body with the excreta, it is not surprising that water, the food most readily polluted with such materials and the one universal food at all ages, should prove to be their most common means of communication from person to person; and hence arises the fact that in this group are found the best known examples of water-borne diseases. Through foods infected directly or indirectly from previous cases seem to be by far the most important vehicles of infection, an ever-increasing body of evidence supports the opinion that, in many instances at least, and for obvious reasons, the infecting agents are conveyed from person to person by direct contact. Ample evidence in favor of possibilities of this mode of trans-

mission is apparent when it is recalled that, in the natural course of events, micro-organisms present in any considerable number in the excreta must gain access by means of the garments to various parts of the body and finally to the hands, at times at least, of the most fastidiously cleanly. However, in this case, it is probable that in most instances the few organisms it is thus possible to convey from one person's hands to another's mouth are not sufficient for an infective dose and that successful conveyance of infection by hands usually requires the medium of some food material in which the micro-organisms may first multiply.

For obvious reasons, the transmission of the causal agents of these affections from the bowel discharges, and even in the case of some of them from the urine, to human food by insects, and notably by flies, is not unusual. Not uncommonly opportunity arises for the spread of some of them, particularly amœbic dysentery, by means of fresh vegetables and fruits eaten raw, such as cabbage, lettuce, cress, strawberries, and the like, which have been manured with night-soil. Possibly for all, and certainly for some of them, the causal agents persist in bowel and bladder discharges for varying periods after recovery. Some of those who have had typhoid fever discharge *B. typhosus* in their urine or feces many years after recovery. The chronic "carrier" exerts an important influence upon the persistence in communities of some of these diseases, notably typhoid fever and amœbic dysentery. Furthermore, for some of these, particularly cholera, typhoid and para-typhoid fevers, and dysentery, the "carrier" state may occasionally exist temporarily in persons who have never had clinical manifestations of infection. Too little is known of the behavior in the outside world of the causes of these diseases as a class to form an intelligent opinion concerning the sources and means of infection unassociated directly or indirectly with human beings as above outlined. At any rate, some of the most prominent, as cholera, typhoid fever, and dysentery, have disappeared for considerable periods of time when the chain of direct and indirect infection between human beings has been broken. It would appear, therefore, that the human being as a host forms a necessary link.

Even a cursory study of their history in Baltimore indicates that the prevalence and lethal force of the acute intestinal affections have been correlated with movements of people, the age and social composition of the population, natural conditions of and artificial interferences with the material environment, and medical care. It is only within comparatively recent years that individual or personal efforts at their control have been put forth seriously. To trace separately and in detail for each member of the group those particular events in the social and sanitary history of the city that bear upon them all in common would involve needless repetition and hopeless confusion. Clarity will be gained by presenting the pertinent facts of the actual course of each affection, particularly in regard to its lethal force over the whole period under review, the relation of the various affections to each other and to the total death-rates for the group, and the conditions which appear to have influenced their course favorably or unfavorably. These acute intestinal affections naturally fall under four statistical headings, as follows: *Diarrhœas—cholera infantum* (rubric 104) and *diarrhœa* (rubric 105); *dysentery; Asiatic cholera; typhoid fever.*

DIARRHŒAS.

The annual number of deaths ascribed to the heading cholera infantum (rubric 104) in the local statistical nosology can not be ascertained before 1821, because they were included with that from cholera morbus. Indeed, it would appear that it was some years later that the separation became sharply cut. While in a general sense it is clear that, after 1824 at least, cholera infantum, in the local statistical nosology, has meant the diarrhœal affections of infants below the completion of the second year of life, it is by no means certain that it was consistently so restricted during all this long period of time. In the special tables for this heading for 1901 to 1904, inclusive, the age period was given as "under 5 years," and it has been only since 1905 that the deaths have been specified as "under 2 years of age." The course of diarrhœa (105) (table 19, graph 5) in comparison with that of cholera infantum (104) between 1880 and 1898, when, on the whole, the former was rising or was holding a high level and the latter was falling, suggests that some deaths of infants certified as due to diarrhœa were classified under this heading instead of under cholera infantum. The sharp rise in the rate for cholera infantum after 1898, associated with a correspondingly abrupt drop for diarrhœa, suggests changes in custom of classification rather than in the relative number of deaths from these two sets of causes.

Between 1812 and 1898 the records show continuously a variable but considerable number of deaths attributed to teething, and during the long period of excessively high rates for cholera infantum between 1845 and 1875 the number of deaths classified under teething were specially numerous. On account of the testimony of physicians in practice, and especially of some of those long identified with the health department, that in the local nosology death from teething was synomyous with death from cholera infantum in the mind of the public and of many physicians, it has seemed necessary to include deaths under this heading in the rubric for cholera infantum. With the adoption of the international classification in 1899, teething as well as cholera infantum gave place to rubric 104. There is evidence that in some cholera years confusion between cholera asiatica and cholera infantum led to the assignment of deaths from one to the other of these two categories. Finally, there is a large possibility that, before 1899, deaths of children under 2 years of age reported as dysentery may have been classified by statistical clerks under that rubric instead of under cholera infantum, contrary to the custom obtaining since the adoption of the international classification.

To few diseases of common occurrence and high fatality has intensive study over a long period of years yielded less in accurate knowledge of direct causation than the gastro-enteritis or diarrhœa of infants. In spite of the large body of valuable information gained in regard to predisposing causes as ill care, unsuitable foods, heat and humidity, cold, the characteristics of the stools, pathological anatomy and general pathology, preventive measures (the use of mother's milk, properly prepared and selected cow's milk, and other foods), the scientific general care of infants, and even medical treatment, definite knowledge of the actual or determinative causes is lacking. Whereas it has long been known that at the same or at different dates there is great difference in the character of the stools of affected infants, particularly in regard to the presence or absence

TABLE 19.—*Number of deaths and rate of death, per 100,000 living inhabitants, from diarrhœa, dysentery, cholera, and typhoid fever, and the percentage of total acute inflammatory infections of the intestinal tract of total deaths, from 1812 to 1920, inclusive.*

D = death. R = rate.

Year.	Diarrhœa.																	
	Diarrhœa, under 2 years of age.						Diarrhœa, 2 years of age and over.										Total.	
	Cholera infantum.		Teething.		Total.		Cholera morbus.		Cramp colic.		Diarrhœa.		Inflammation of bowels.		Total.			
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1812 ..	...	...	2	5	2	5	174	425	8	20	1	2	...	...	183	447	185	452
1813 ..	...	...	6	14	6	14	179	418	11	26	...	...	...	...	190	444	196	458
1814 ..	...	...	4	9	4	9	102	228	18	40	...	...	...	...	120	268	124	277
1815 ..	...	...	9	19	9	19	167	357	8	17	...	...	...	...	175	374	184	394
1816 ..	...	...	3	6	3	6	132	270	16	33	...	...	...	...	148	303	151	309
1817 ..	...	...	9	18	9	18	214	420	9	18	...	...	...	...	223	438	232	455
1818 ..	...	...	16	30	16	30	280	526	15	28	...	...	4	8	299	562	315	592
1819 ..	...	...	27	49	27	49	121	218	4	7	...	...	1	2	126	227	153	276
1820 ..	...	...	20	35	20	35	175	302	17	29	2	3	5	9	199	344	219	379
1821 ..	197	327	9	15	206	342	12	20	26	43	10	17	2	3	50	83	256	425
1822 ..	260	414	16	25	276	439	5	8	15	24	9	14	1	2	30	48	306	487
1823 ..	253	387	13	20	266	407	...	...	9	14	...	...	6	9	15	23	281	430
1824 ..	90	132	4	6	94	138	5	7	11	16	1	1	8	12	25	37	119	175
1825 ..	93	131	14	20	107	151	7	10	17	24	37	52	...	...	61	86	168	237
1826 ..	119	162	8	11	127	172	11	15	17	23	...	...	1	1	29	39	156	212
1827 ..	77	101	11	14	88	115	12	16	13	17	...	...	6	8	31	40	119	155
1828 ..	110	138	16	20	126	158	9	11	7	9	1	1	10	13	27	34	153	192
1829 ..	140	170	1	1	141	171	7	8	15	18	...	...	8	10	30	36	171	207
1830 ..	182	212	8	9	190	222	40	47	7	8	...	...	10	12	57	67	247	288
1831 ..	248	279	18	20	266	299	9	10	9	10	3	3	7	8	28	32	294	331
1832 ..	332	360	16	17	348	378	2	2	22	24	1	1	17	18	42	46	390	423
1833 ..	146	153	17	18	163	171	2	2	8	8	...	...	22	23	32	34	195	204
1834 ..	201	203	23	23	224	226	35	35	23	23	1	1	14	14	73	74	297	300
1835 ..	89	87	23	22	112	109	5	5	10	10	...	...	15	15	30	29	142	139
1836 ..	191	180	16	15	207	195	2	2	6	6	2	2	15	14	25	24	232	219
1837 ..	131	120	28	26	159	145	...	...	9	8	...	...	10	9	19	17	178	162
1838 ..	199	176	21	19	220	194	2	2	4	4	...	...	14	12	20	18	240	212
1839 ..	125	107	15	13	140	120	2	2	3	3	1	1	20	17	26	22	166	142
1840 ..	114	94	21	17	135	112	1	1	7	6	...	...	21	17	29	24	164	136
1841 ..	194	155	28	22	222	178	...	...	4	3	...	...	36	29	40	32	262	210
1842 ..	198	154	29	22	227	176	9	7	4	3	2	2	46	36	61	47	288	223
1843 ..	159	119	29	22	188	141	8	6	10	8	...	...	46	35	64	48	252	189
1844 ..	129	94	16	12	145	106	6	4	5	4	1	1	37	27	49	36	194	141
1845 ..	113	80	19	13	132	93	7	5	12	8	...	...	34	24	53	37	185	131
1846 ..	139	95	42	29	181	124	4	3	8	5	...	...	51	35	63	43	244	167
1847 ..	249	166	69	46	318	212	...	...	4	3	7	5	60	40	71	47	389	259
1848 ..	244	158	92	59	336	217	...	...	6	4	15	10	67	43	88	57	424	274
1849 ..	290	182	102	64	392	246	32	20	9	6	69	43	46	29	156	98	548	344
1850 ..	347	212	99	60	446	272	27	16	9	5	40	24	54	33	130	79	576	351
1851 ..	290	172	93	55	383	227	6	4	11	7	15	9	66	39	98	58	481	285
1852 ..	339	195	120	69	459	265	10	6	13	8	49	28	78	45	150	86	609	351
1853 ..	256	144	94	53	350	196	11	6	28	16	34	19	80	45	153	86	503	282
1854 ..	395	216	114	62	509	278	129	70	111	61	39	21	55	30	334	182	843	460
1855 ..	418	222	169	90	587	312	22	12	22	12	30	16	88	47	162	86	749	398
1856 ..	568	294	206	107	774	400	14	7	11	6	6	3	88	46	119	62	893	462
1857 ..	410	207	206	104	616	310	12	6	24	12	14	7	74	37	124	62	740	373
1858 ..	361	177	210	103	571	280	10	5	32	16	7	3	87	43	136	67	707	347
1859 ..	386	185	163	78	549	263	17	8	21	10	16	8	68	33	122	58	671	321
1860 ..	328	153	204	95	532	248	13	6	25	12	6	3	84	39	128	60	660	308
1861 ..	325	148	225	102	550	250	8	4	48	22	8	4	63	29	127	58	677	308
1862 ..	266	118	157	70	423	188	13	6	57	25	15	7	55	24	140	62	563	250
1863 ..	287	124	157	68	444	192	13	6	77	33	13	6	57	25	160	69	604	261
1864 ..	309	130	150	63	459	194	10	4	87	37	9	4	68	29	174	73	633	267
1865 ..	285	117	112	46	397	164	30	12	79	33	21	9	61	25	191	79	588	242
1866 ..	340	137	151	61	491	198	40	16	109	44	21	8	41	17	211	85	702	283

TABLE 19.—*Number of deaths and rate of death, per 100,000 living inhabitants, from diarrhœa, dysentery, cholera, and typhoid fever, etc.*—Continued.

D = death. R = rate.

Year.	Diarrhœa.																	
	Diarrhœa, under 2 years of age.						Diarrhœa, 2 years of age and over.										Total.	
	Cholera infantum.		Teething.		Total.		Cholera morbus.		Cramp colic.		Diarrhœa.		Inflammation of bowels.		Total.			
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1867 ..	257	101	230	90	487	191	14	6	159	62	6	2	51	20	230	90	717	282
1868 ..	356	137	307	118	663	255	17	7	153	59	8	3	40	15	218	84	881	338
1869 ..	332	125	284	107	616	231	23	9	121	45	10	4	61	23	215	81	831	312
1870 ..	450	165	272	100	722	265	20	7	195	72	4	1	52	19	271	99	993	364
1871 ..	286	103	226	81	512	184	23	8	215	77	12	4	52	19	302	108	814	292
1872 ..	638	224	293	103	931	326	39	14	60	21	9	3	69	24	177	62	1108	388
1873 ..	598	205	274	94	872	299	26	9	...	...	15	5	122	42	163	56	1035	355
1874 ..	766	257	284	95	1050	352	23	8	...	...	13	4	176	59	212	71	1262	423
1875 ..	643	211	119	39	762	250	22	7	...	...	97	32	73	24	192	63	954	313
1876 ..	702	226	136	44	838	269	24	8	...	...	147	47	79	25	250	80	1088	350
1877 ..	615	193	143	45	758	238	16	5	...	...	136	43	89	28	241	76	999	314
1878 ..	343	106	79	24	422	130	14	4	...	...	164	51	35	11	213	66	635	196
1879 ..	475	143	98	30	573	172	18	5	...	...	160	48	40	12	218	66	791	239
1880 ..	503	149	104	31	607	179	25	7	...	...	120	35	63	19	208	61	815	241
1881 ..	558	161	115	33	673	195	34	10	...	...	221	64	61	18	316	91	989	286
1882 ..	399	113	87	25	486	138	23	7	...	...	166	47	62	18	251	71	737	209
1883 ..	473	131	91	25	564	157	18	5	...	...	167	46	62	17	247	69	811	225
1884 ..	496	135	104	28	600	163	16	4	...	...	240	65	56	15	312	85	912	248
1885 ..	498	133	99	26	597	159	28	7	...	...	186	50	56	15	270	72	867	232
1886 ..	485	127	98	26	583	153	13	3	...	...	238	62	65	17	316	83	899	235
1887 ..	567	146	111	29	678	174	29	7	...	...	277	71	85	22	391	100	1069	275
1888 ..	651	155	105	25	756	180	30	7	...	...	330	79	79	19	439	105	1195	285
1889 ..	572	134	99	23	671	157	24	6	...	...	374	88	76	18	474	111	1145	268
1890 ..	507	117	128	29	635	146	23	5	...	...	418	96	105	24	546	126	1181	272
1891 ..	531	120	102	23	633	143	27	6	...	...	342	77	70	16	439	99	1072	243
1892 ..	661	147	126	28	787	175	29	6	...	...	445	99	104	23	578	129	1365	304
1893 ..	444	97	112	25	556	122	35	8	...	...	351	77	91	20	477	104	1033	226
1894 ..	440	95	77	17	517	111	18	4	...	...	419	90	72	16	509	110	1026	221
1895 ..	510	108	95	20	605	129	17	4	...	...	400	85	77	16	494	105	1099	233
1896 ..	412	86	68	14	480	100	22	5	...	...	373	78	92	19	487	102	967	202
1897 ..	401	83	75	15	476	98	14	3	...	...	410	84	80	16	504	104	980	202
1898 ..	386	78	65	13	451	91	12	2	...	...	490	99	18	4	520	105	971	197
1899 ..	703	141	...	...	703	141	16	3	...	...	165	38	...	...	181	36	884	177
1900 ..	848	167	...	...	848	167	6	1	...	...	105	21	...	...	111	22	959	189
1901 ..	726	141	...	...	726	141	7	1	...	...	88	17	...	...	95	18	821	160
1902 ..	695	133	...	...	695	133	16	3	...	...	82	16	...	...	98	19	793	152
1903 ..	550	104	...	...	550	104	8	2	...	...	68	13	...	...	76	14	626	119
1904 ..	671	126	...	...	671	126	6	1	...	...	72	13	...	...	78	15	749	140
1905 ..	751	139	...	...	751	139	4	1	...	...	86	16	...	...	90	17	841	156
1906 ..	623	114	...	...	623	114	4	1	...	...	86	16	...	...	90	16	713	130
1907 ..	747	135	...	...	747	135	11	2	...	...	122	22	...	...	133	24	880	159
1908 ..	591	106	...	...	591	106	15	3	...	...	109	19	...	...	124	22	715	128
1909 ..	562	99	...	...	562	99	5	1	...	...	119	21	...	...	124	22	686	121
1910 ..	598	105	...	...	598	105	6	1	...	...	113	20	...	...	119	21	717	125
1911 ..	568	98	...	...	568	98	3	1	...	...	83	14	...	...	86	15	654	113
1912 ..	501	86	...	...	501	86	3	1	...	...	88	15	...	...	91	16	592	101
1913 ..	558	95	...	...	558	95	2	...	...	...	83	14	...	...	85	14	643	109
1914 ..	564	95	...	...	564	95	...	...	...	...	78	13	...	...	78	13	642	108
1915 ..	480	80	...	...	480	80	...	...	...	...	91	15	...	...	91	15	571	95
1916 ..	581	96	...	...	581	96	...	...	...	...	83	14	...	...	83	14	664	109
1917 ..	635	104	...	...	635	104	...	...	...	...	101	16	...	...	101	16	736	120
1918 ..	795	129	...	...	795	129	...	...	...	...	143	23	...	...	143	23	938	152
1919 ..	616	85	...	...	616	85	...	...	...	...	134	19	...	...	134	19	750	104
1920 ..	663	90	...	...	663	90	...	...	...	...	105	14	...	...	105	14	768	105

TABLE 19.—*Number of deaths and rate of death, per 100,000 living inhabitants, from diarrhœa, dysentery, cholera, and typhoid fever, etc.*—Continued.

D = death. R = rate.

Year.	Dysentery.		Cholera.		Typhoid fever.										Grand total.		Per cent. of total deaths.
					Nervous fever.		Gastric fever.		Typho-malarial fever.		Typhoid fever.		Total.				
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	
1812 ...	...	...	...	...	2	5	...	...	...	...	...	...	2	5	187	457	16
1813 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	196	458	17
1814 ...	6	13	...	...	3	7	...	...	...	...	...	...	3	7	133	297	12
1815 ...	7	15	...	...	1	2	...	...	...	...	...	...	1	2	192	411	14
1816 ...	12	25	...	...	5	10	...	...	...	...	...	...	5	10	168	344	13
1817 ...	10	20	...	...	2	4	...	...	...	...	...	...	2	4	244	479	18
1818 ...	31	58	...	...	7	13	...	...	...	...	...	...	7	13	353	664	21
1819 ...	26	47	...	...	2	4	...	...	...	...	...	...	2	4	181	326	8
1820 ...	64	111	...	...	5	9	...	...	...	...	...	...	5	9	288	498	19
1821 ...	41	68	...	...	5	8	...	...	...	...	...	...	5	8	302	501	16
1822 ...	56	89	...	...	...	...	...	...	...	...	...	...	...	...	362	576	16
1823 ...	46	70	...	...	9	14	...	...	...	...	...	...	9	14	336	514	17
1824 ...	13	19	...	...	2	3	...	...	...	...	...	...	2	3	134	197	10
1825 ...	30	42	...	...	...	...	...	...	...	...	...	...	...	...	198	280	14
1826 ...	47	64	...	...	...	...	...	...	...	...	...	...	...	...	203	276	11
1827 ...	20	26	...	...	...	...	...	...	...	...	...	...	...	...	139	181	10
1828 ...	20	25	...	...	...	...	...	...	...	...	...	...	...	...	173	218	11
1829 ...	12	15	...	...	...	...	...	...	...	...	...	...	...	...	183	222	11
1830 ...	21	25	...	...	...	...	...	...	...	...	...	...	...	...	268	313	14
1831 ...	24	27	...	...	...	...	...	...	...	...	...	...	...	...	318	358	15
1832 ...	58	63	853	926	...	...	...	...	...	...	...	...	...	...	1301	1412	38
1833 ...	32	34	...	...	...	...	...	...	...	...	...	...	...	...	227	238	10
1834 ...	39	39	71	72	...	...	...	...	...	...	...	...	...	...	407	412	16
1835 ...	28	27	...	...	...	...	...	...	...	...	...	...	...	...	170	166	9
1836 ...	25	24	...	...	...	...	...	...	...	...	...	...	...	...	257	243	9
1837 ...	39	36	...	...	...	...	3	3	...	...	...	...	3	3	220	201	9
1838 ...	25	22	...	...	...	...	5	4	...	...	...	...	5	4	270	238	11
1839 ...	16	14	...	...	...	...	8	7	...	...	...	...	8	7	190	162	8
1840 ...	27	22	...	...	...	...	10	8	...	...	...	...	10	8	201	166	10
1841 ...	22	18	...	...	...	...	7	6	...	...	...	...	7	6	291	233	13
1842 ...	25	19	...	...	...	...	12	9	...	...	...	...	12	9	325	252	13
1843 ...	22	17	...	...	1	1	17	13	...	...	...	...	18	14	292	219	13
1844 ...	13	9	...	...	2	1	22	16	...	...	...	...	24	17	231	168	9
1845 ...	13	9	1	1	2	1	36	25	...	...	...	...	38	27	237	167	8
1846 ...	7	5	...	...	...	...	25	17	...	...	...	...	25	17	276	189	9
1847 ...	42	28	...	...	...	...	29	19	...	...	...	...	29	19	460	306	13
1848 ...	46	30	...	...	4	3	20	13	...	...	...	...	24	16	494	319	13
1849 ...	148	93	...	...	4	3	21	13	...	...	...	...	25	16	721	453	17
1850 ...	237	145	...	...	3	2	30	18	...	...	...	...	33	20	846	516	20
1851 ...	161	95	...	...	...	...	19	11	...	...	71	42	90	53	732	434	18
1852 ...	222	128	...	...	...	...	14	8	...	...	78	45	92	53	923	532	19
1853 ...	242	136	...	...	...	...	18	10	...	...	101	57	119	67	864	485	18
1854 ...	252	138	2	1	...	...	15	8	...	...	95	52	110	60	1207	659	23
1855 ...	202	107	...	...	...	...	14	7	...	...	94	50	108	57	1059	563	21
1856 ...	213	110	...	...	...	...	13	7	...	...	69	36	82	42	1188	614	23
1857 ...	141	71	...	...	...	...	10	5	...	...	84	42	94	47	975	491	19
1858 ...	137	67	...	...	...	...	7	3	...	...	100	49	107	53	951	467	18
1859 ...	104	50	...	...	...	...	9	4	...	...	92	44	101	48	876	419	19
1860 ...	59	28	...	...	...	...	8	4	...	...	101	47	109	51	828	386	17
1861 ...	51	23	...	...	...	...	9	4	...	...	167	76	176	80	904	411	19
1862 ...	43	19	...	...	...	...	11	5	...	...	202	90	213	94	819	363	16
1863 ...	60	26	...	...	...	...	12	5	...	...	168	73	180	78	844	365	15
1864 ...	73	31	...	...	...	...	5	2	...	...	200	84	205	87	911	385	16
1865 ...	67	28	...	...	...	...	4	2	...	...	171	70	175	72	830	342	18
1866 ...	67	27	62	25	...	...	5	2	...	...	196	79	201	81	1032	415	18

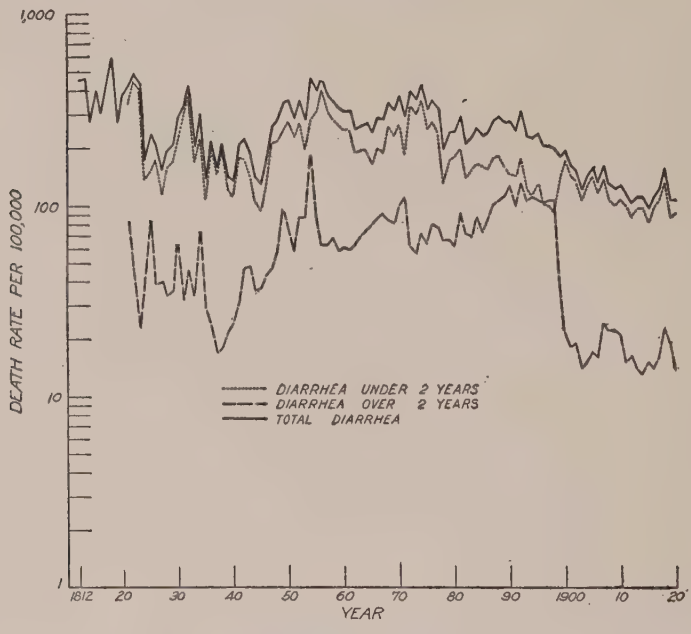
TABLE 19.—*Number of deaths and rate of death, per 100,000 living inhabitants, from diarrhœa, dysentery, cholera, and typhoid fever, etc.*—Continued.

D = death. R = rate.

Year.	Dysentery.		Cholera.		Typhoid fever.										Grand total.		Per cent. of total deaths.
					Nervous fever.		Gastric fever.		Typho-malarial fever.		Typhoid fever.		Total.				
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	
1867 ...	63	25	...	...	...	...	11	4	...	...	235	92	246	97	1026	403	19
1868 ...	85	33	...	...	...	...	9	3	...	...	167	64	176	68	1142	438	18
1869 ...	83	31	...	...	...	...	14	5	...	...	210	79	224	84	1138	427	18
1870 ...	65	24	...	...	...	...	25	9	...	...	265	97	290	106	1348	494	19
1871 ...	83	30	...	...	...	...	9	3	...	...	200	72	209	75	1106	397	15
1872 ...	71	25	...	...	...	...	15	5	...	...	229	80	244	86	1423	499	16
1873 ...	76	26	...	...	...	...	15	5	...	...	230	79	245	84	1356	465	18
1874 ...	71	24	...	...	...	...	16	5	...	...	226	76	242	81	1575	528	21
1875 ...	48	16	...	...	...	...	25	8	...	...	187	61	212	70	1214	398	17
1876 ...	57	18	...	...	...	...	...	...	6	2	177	57	183	59	1328	427	18
1877 ...	49	15	4	1	...	...	...	...	...	...	212	67	212	67	1264	397	16
1878 ...	41	13	...	...	...	...	3	1	...	...	177	55	180	55	856	264	13
1879 ...	60	18	2	1	...	...	6	2	17	5	167	50	190	57	1043	314	14
1880 ...	57	17	...	...	...	...	5	1	31	9	197	58	233	69	1105	326	14
1881 ...	56	16	...	...	...	...	5	1	50	14	197	57	252	73	1297	375	15
1882 ...	62	18	...	...	...	...	1	...	44	12	165	47	210	60	1009	286	11
1883 ...	52	14	...	...	...	...	3	1	48	13	126	35	177	49	1040	289	11
1884 ...	43	12	...	...	...	...	4	1	66	18	151	41	221	60	1176	320	14
1885 ...	60	16	...	...	...	...	...	...	75	20	155	41	230	61	1157	309	14
1886 ...	84	22	...	...	...	...	1	...	58	15	150	39	209	55	1192	312	14
1887 ...	138	35	...	...	...	...	...	...	55	14	156	40	211	54	1418	364	17
1888 ...	167	40	...	...	...	...	...	...	41	10	161	38	202	48	1564	373	18
1889 ...	156	37	...	...	...	...	...	...	33	8	191	45	224	52	1525	357	18
1890 ...	212	49	...	...	...	...	...	...	54	12	247	57	301	69	1694	390	17
1891 ...	18	4	...	...	...	...	...	...	39	9	150	34	189	43	1279	289	13
1892 ...	109	24	...	...	...	...	...	...	33	7	193	43	226	50	1700	378	16
1893 ...	62	14	...	...	...	...	...	...	31	7	224	49	255	56	1350	296	14
1894 ...	72	16	...	...	...	...	...	...	35	8	222	48	257	55	1355	292	14
1895 ...	70	15	...	...	...	...	...	...	19	4	173	37	192	41	1361	289	13
1896 ...	82	17	...	...	...	...	...	...	16	3	188	39	204	43	1253	262	13
1897 ...	57	12	...	...	...	...	1	...	20	4	189	39	210	43	1247	257	13
1898 ...	82	17	...	...	...	...	...	...	12	2	189	38	201	41	1254	254	12
1899 ...	57	11	...	...	...	...	...	...	...	...	153	31	153	31	1094	219	11
1900 ...	77	15	...	...	...	...	...	...	...	...	189	37	189	37	1225	242	11
1901 ...	49	10	...	...	...	...	...	...	...	...	141	27	141	27	1011	197	10
1902 ...	78	15	...	...	...	...	...	...	...	...	220	42	220	42	1091	210	11
1903 ...	40	8	...	...	...	...	...	...	...	...	189	36	189	36	855	162	8
1904 ...	54	10	...	...	...	...	...	...	...	...	199	37	199	37	1002	188	9
1905 ...	44	8	...	...	...	...	...	...	...	...	197	36	197	36	1082	200	10
1906 ...	37	7	...	...	...	...	...	...	...	...	183	33	183	33	933	171	9
1907 ...	48	9	...	...	...	...	...	...	...	...	230	42	230	42	1158	209	10
1908 ...	35	6	...	...	...	...	...	...	...	...	180	32	180	32	930	166	9
1909 ...	33	6	...	...	...	...	...	...	...	...	136	24	136	24	855	151	8
1910 ...	31	5	...	...	...	...	...	...	...	...	235	41	235	41	983	172	9
1911 ...	25	4	...	...	...	...	...	...	...	...	154	27	154	27	833	144	8
1912 ...	17	3	...	...	...	...	...	...	...	...	136	23	136	23	745	128	7
1913 ...	21	4	...	...	...	...	...	...	...	...	135	23	135	23	799	135	8
1914 ...	10	2	...	...	...	...	...	...	...	...	130	22	130	22	782	131	7
1915 ...	12	2	...	...	...	...	...	...	...	...	128	21	128	21	711	118	7
1916 ...	7	1	...	...	...	...	...	...	...	...	107	18	107	18	778	128	7
1917 ...	5	1	...	...	...	...	...	...	...	...	92	15	92	15	833	136	7
1918 ...	5	1	...	...	...	...	...	...	...	...	73	12	73	12	1016	164	6
1919 ...	3	...	...	...	...	...	...	...	...	...	60	8	60	8	813	113	7
1920 ...	22	3	...	...	...	...	...	...	...	...	35	5	35	5	825	112	7

of blood and pus, it has been commonly assumed that the affection is a single and distinct entity, and the work of pathological anatomists and of bacteriologists, including that of Booker (54), in 1895, who found streptococci in the intestinal lesions of a group of cases, and of Duval and Bassett (55), in 1902, who cultivated varieties of *B. dysenteriæ* from the stools of certain Baltimore cases, did not seriously upset this prevailing conception.

The recent demonstration by Professor John Howland (personal communication) and his coworkers that *B. dysenteriæ,* in relation to infantile diarrhœas in Baltimore, is confined strictly to cases with bloody stools and that this form of bowel affection occurs from time to time in epidemic outbreaks in widely separated areas in Baltimore and may spread among children with other affec-



Graph 5 (from table 19). Annual crude mortality rates from diarrhœa, from 1812 to 1920, inclusive.

tions in a well administered hospital when cases are admitted to the wards, is of far-reaching importance. Thus, for Baltimore, it appears to be conclusively established that this rubric, cholera infantum, consists of at least two separate elements, the dysentery and the non-dysentery. The dysentery type of infantile enteritis is often particularly fatal, but no data exist for comparing its lethal powers with the group or groups of other types and causation. That dysentery was an important cause of death among infants is shown by the high death-rate under 1 year of age from this disease in 1850. William T. Howard, sr. (86), was struck with the close relationship between cholera infantum and dysentery, and in his lectures written about 1870 stated that when the infant in a family became ill with cholera infantum, older children in the same household were often attacked by typical dysentery.

It will be noted from table 19 that high death-rates from cholera infantum have often, but by no means invariably, synchronized in time with high rates for dysentery, and there would appear to be a rough sort of correlation in the simultaneous fall in these two rates particularly during the last few years. However, since knowledge concerning the proportional distribution of the deaths ascribed to dysentery among the several varieties of this disease as clinically and anatomically defined is entirely lacking, any attempt at close comparison between its course and that of cholera infantum is manifestly unwarranted. Whether the non-dysentery moiety of infantile enteritis is due to the same indefinite congeries of causes, to which the diarrhœas of older children and adults is ascribed, is, of course, unknown. It must be clearly recognized that, as here used, cholera infantum is from neither the etiological nor the anatomical standpoints a specific disease entity, but that it embraces deaths which under a proper causal classification would be ascribed to dysentery, and in other ways it is not strictly comparable with diarrhœa (rubric 105), which, in theory at least, avowedly excludes all dysenteries.

Assuming for the purpose of the present study that the figures recorded for deaths from cholera infantum and teething are correct, and that these headings taken together represent, from 1821 to 1898, the later rubric 104 of the international classification, the course of its force of mortality may be followed for 100 years. Such rates are far from specific as regards age of those exposed to risk and much less so than those calculated for dysentery and for diarrhœa. For according to definition, in calculating the rates for the latter rubric, the divisor includes erroneously the relatively small age-group under the second year of age and from the dividend the deaths from these affections within this age-group are excluded, while in the rates for cholera infantum the divisor includes the comparatively great moiety of population above the second year used upon a dividend represented by the number of deaths within this very restricted age group. On this basis, for direct comparison, the rates for cholera infantum would have to be multiplied something over 20 times. And again, strict comparison of the rates for this rubric for the earlier years with those of the later years is unwarranted because of changes in the age-groupings of the population. It is evident that the rate for cholera infantum would be materially affected by changes in the birth-rate, and by the rise and fall in the death rates from such affections as measles, scarlet fever, whooping-cough, and diphtheria.

Even while *bearing constantly* in mind these various explanations and reservations made necessary by the character of the data available (from study of table 19 and graph 5), it is abundantly evident that the annual rates for cholera infantum, as calculated, are not only very high and show frequently substantial variations from year to year, but exhibit several major and minor waves often extending over periods embracing a considerable number of years. In other words, the force of mortality, always considerable, has often varied widely from year to year and from period to period in the population's history. Beginning some time before 1821 and ending in 1823, there was a wave of appalling mortality. The rate for 1822 (439 per 100,000 total population, but something like 10,000 per 100,000, or 1 in every 10 exposed to risk, i. e., under the second year of age) was higher than any since recorded. A rate even higher probably obtained in 1818. The abrupt fall in 1824, with the slight rise during the next 2 years, was followed by the termination of this wave in 1827 with

a rate of 115. A second wave starting in 1828 reached its peak in 1832 (the year of the great cholera epidemic) with a rate of 378; after a substantial fall the next year and a minor rise in 1834 (the second cholera year), it fell to a low point (109) in 1835. This sharply cut wave, attended with correspondingly higher rates for diarrhœa, and with a rate higher than usual for dysentery in the peak year (1832), covered a period of 7 years. The next 10 years was a period of relatively low rates, with considerable annual fluctuation, and in 1845 the remarkably low rate of 93 was attained. During this 10-year period the rates for dysentery were low and on the whole declining, and those for diarrhœa, which fell during the first half, rose correspondingly in the second half.

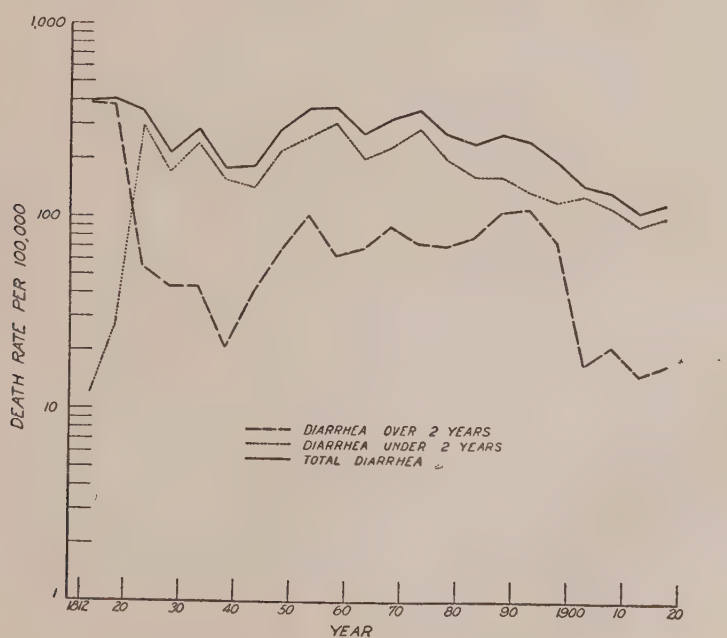
The year 1846 signaled the beginning of a third wave of mortality, which, mounting gradually and broken now and again by slight recessions, reached its peak in 1856 with a rate of 400, and descending gradually, subsided in 1865 with a rate of 164. During the first half of this 20-year wave the rates for both diarrhœa and dysentery were high, and indeed reached their highest recorded level, the latter in 1850 and the former in 1854 (a cholera year, when, however, practically all the deaths from cholera must have been credited to diarrhœa and cholera infantum). During the last half of the period the rates for dysentery subsided sharply and markedly and those for diarrhœa first fell and later rose.

It will be noted that cholera infantum achieved its highest rate 2 years later than diarrhœa and 6 years later than dysentery. In a fourth great wave, extending from 1866 to 1878, the rise to the crest, reached in 1874 (with a rate of 352), was gradual and broken frequently by larger and smaller recessions, while the descent was marked by an almost continuous fall to the comparatively low rate of 130 in 1878. During this whole period the rates for dysentery were low, and during the descent of the wave for cholera infantum the curves for the two rubrics followed the same general course. The rates for diarrhœa, on the other hand, continued until in 1871 the very definite ascent begun in 1861, but fell decidedly during the peak of the wave for cholera infantum, only to ascend again during the years of the latter's decline. The low point attained at the end of the fourth wave was lower than that of the third but considerably higher than those of the first and second waves. From 1879 to 1892 the course of the curve for cholera infantum was fairly even, with rates varying between 153 and 195. The rates for diarrhœa ascended gradually to the highest point attained in years, and a sharp rise in the rates for dysentery (1886–1890) was apparently without influence upon those of cholera infantum. Between 1899 and 1907, in the face of a sharp drop in the rates for diarrhœa and the continued descent for those for dysentery, the rates for cholera infantum completely reversed their course. Then until 1915, in the face of low and fairly well stabilized rates for diarrhœa and the descent of those for dysentery to nearly the vanishing-point, the rates for cholera infantum fell, with some fluctuations, to 80, the lowest point recorded in the city's history. A sharp rise in cholera infantum during the next 3 years to a rate of 129 and a decline in 1919 to 85 were associated with corresponding changes in the rates for diarrhœa. Finally, the slight rise in cholera infantum in 1920 synchronized with a similar change in dysentery, an association possibly significant.

Turning now to the consideration of the annual rates averaged for 5- and 10-year periods, from 1821 to 1920, inclusive (table 20, graph 6), and making

TABLE 20.—*Average rate of death by 5- and 10-year periods from acute inflammatory infections of intestinal tract, from 1812 to 1920, inclusive.*

Period.	Diarrhœa.						Dysentery.		Cholera.		Typhoid fever.		Total.	
	Diarrhœa under 2 years of age.		Diarrhœa over 2 years of age.		Total.									
	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.
1812 to 15...	12	....	383	....	395	....	7	....	....	....	3	....	406	....
1816 to 20...	27	20	375	379	402	399	52	32	....	....	8	6	462	437
1821 to 25...	295	....	55	....	350	....	58	....	....	....	5	....	413	....
1826 to 30...	168	232	43	50	211	282	31	44	....	....	....	3	242	328
1831 to 35...	237	....	43	....	280	....	38	....	200	....	....	....	517	....
1836 to 40...	153	195	21	32	174	227	23	31	....	100	4	2	202	360
1841 to 45...	139	....	40	....	179	....	14	....	....	....	15	....	208	....
1846 to 50...	214	176	65	53	279	229	60	37	....	....	18	16	357	282
1851 to 55...	256	....	100	....	356	....	121	....	....	....	58	....	534	....
1856 to 60...	300	278	62	81	362	359	65	93	....	....	48	53	475	505
1861 to 65...	197	....	68	....	265	....	25	....	....	....	82	....	373	....
1866 to 70...	228	213	88	78	316	291	28	27	5	3	87	85	436	404
1871 to 75...	282	....	72	....	354	....	24	....	....	....	79	....	457	....
1876 to 80...	198	240	70	71	268	311	16	20	....	....	61	70	346	402
1881 to 85...	162	....	78	....	240	....	15	....	....	....	61	....	316	....
1886 to 90...	162	162	105	91	267	253	37	26	....	....	56	58	359	338
1891 to 95...	136	....	109	....	245	....	14	....	....	....	49	....	309	....
1896 to 1900.	120	128	74	92	194	220	14	14	....	....	39	44	247	278
1901 to 05...	129	....	17	....	146	....	10	....	....	....	36	....	191	....
1906 to 10...	112	120	21	19	133	139	7	8	....	....	34	35	174	182
1911 to 15...	90	....	15	....	105	....	3	....	....	....	23	....	131	....
1916 to 20...	101	95	17	16	118	111	1	2	....	....	12	17	131	131



GRAPH 6 (from table 20). Crude mortality rates from diarrhœa, averaged by 5-year periods, from 1812 to 1920, inclusive.

the necessary allowances for this arbitrary division in the time relationships, a very clear-cut picture is obtained of the lethal course of cholera infantum during 100 years. The 5-year averaged rates fell from the high level of 295 in 1821–1825 to 168 in 1826–1830. The peak of a second wave stands out in 1831–1835 with a rate of 237, which was followed by a gradual decline to a rate of 139 in 1841–1845. A third wave, with a gradual rise in rates during 15 years to a peak-rate of 300 in 1856–1860, had receded to a rate of 197 in 1861–1865, when its further fall was arrested by the beginning of a fourth wave. The latter reaching its crest in 1871–1875 with a rate of 282, during the next 10 years fell to 162, a level maintained for the 5 years ending in 1890. From this point, except for a slight rise in 1901–1905, there was an uninterrupted decline until 1911–1915, when the averaged rates stood at 90, the lowest level reached. During the last 5 years the rate reacted slightly to 101.

With the annual rates averaged for 10-year periods beginning in 1821, the second wave above noted is smoothed out and by 1846–1850 the rate had fallen from the initial figure 232 in 1826–1830 to 176. For the 10 years ending in 1860 the high rate of 278 was attained. A drop in these rates to 213 in 1866–1870 was followed by a rise of 240 in 1876–1880. During the succeeding 40 years the rates fell steadily and almost uniformly to 95 in 1911–1920.

The period ending in 1880 marked the turning point of the curves for both the 5- and 10-year averaged rates. When these pictures are viewed with a critical eye, certain points stand out with striking distinctness. Previous to the beginning of the present records there had occurred a long wave of high mortality marked by minor fluctuations and extending to some date prior to 1821, which, for some reason or reasons not entirely clear, began to recede between 1826–1830 and 1836–1840 and reached its ebb about 1841–1845. After 1845 there began a second long wave (broken by two sharp crests) whose recession began about 1876–1880, and by 1891–1895 the averaged annual rate stood at about the same level of that of 1841–1845. These intermediate 50 years witnessed sensational changes in the lethal force of this affection. The action of the cause or causes concerned began suddenly and attained maximum intensity between 1841–1845 and 1856–1860. Operating with somewhat lessened intensity during the next 5 or 10 years, they exhibited a final outburst of force between 1870 and 1880, and, losing power steadily since the latter date, they have shown no evidence of a capacity to regain their former vigor. Whatever the character of these causes, it is very clear that, after losing to a considerable degree about 1841–1845 the force which they had exerted during a long series of years, they regained it with renewed strength after this date and, after holding the field with power scarcely abated for about 30 years, they subsided very decidedly after 1880.

Since over such long stretches of time the data on which these crude rates are based have been subject to such a variety of influences, concerned particularly with changes in the birth-rate and in the death-rates for many diseases and resulting marked differences in the age distributions of the population for which it is impossible to make accurate allowances, it is important to seek rates specific for age at least at different periods. The results for the 8 census years from 1850 to 1920, inclusive, are presented in table 21. Except in 1900 and 1910, the population figures used are only approximations; hence the rates

derived may be regarded as only relatively accurate. Assuming that they are comparable within a reasonably small degree of error, it appears that the rate rose from about 3,300 in 1850 to about 4,200 in 1860 and, remaining unchanged in 1870, fell by 1890 to approximately the level of 1850. Between 1890 and 1900 it rose from about 3,400 to about 3,700, and falling to 2,700 in 1910, reached the comparatively low level of 2,200 by 1920.

From table 22 the influence of sex and color upon the death-rate from cholera infantum is shown for both the first and the second year of life, for the 6 years 1910 to 1915. Under the first year of age the rates for males, both white and colored, were higher than those for females in every year but one; in the second year of age the rates for males were higher than those for females, in whites in 4 and in colored in 2 out of the 6 years. For both years taken together the

TABLE 21.—*Rate of death, per 100,000 living inhabitants under two years of age, from diarrhœa under two years of age, calculated on estimated populations under two years, except in 1900 and 1910 when census count was obtainable.*

Year.	Population under 2 years.	Diarrhœa under 2 years of age.		Remarks.
		Deaths.	Rate.	
1850	12472	407	3263	The number of deaths for each designated year represents an average of the deaths for that year and for those next preceding and following, except for 1920, when the number of deaths represents an average of the deaths for 1919 and 1920.
1860	12742	544	4269	
1870	14544	617	4242	
1880	16227	618	3808	
1890	18762	646	3443	
1900	20220	759	3754	
1910	19851	543	2735	
1920	28902	640	2214	

rates were higher in males than in females in whites in 4 and in colored in 5 out of the 6 years. The rates for the first and second years of age averaged for the 6 years were for white males 2,660, white females 2,355, colored males 5,197, colored females 4,416. When these are compared it is seen that the rates were 13 per cent higher in white males than in white females, 18 per cent higher in colored males than in colored females, 95 per cent higher in colored males than in white males, and 88 per cent higher in colored females than in white females. The advantage lay distinctly with the female over the male and with the white over the negro.

Probably always, but certainly since the distribution of deaths by months has been recorded (since 1860), the highest monthly mortality rates have fallen in the warm months. July and August commonly show the highest monthly rates. The monthly rates for sex, age, and color are shown in a typical year in table 23. According to Frick's calculations, in 1850 the proportion of deaths from cholera infantum to the 10,000 inhabitants was 22.5 for whites and 10.6 for blacks. Of the whole number of deaths in both races, 48 per cent were in males and 52 per cent in females.

In 1917, a typical recent year, of the deaths from all causes in children in the first and second years of life the percentages due to cholera infantum in the

former age-group were for whites 31.5, for negroes 26, for total 30.3, and in the latter age-group, for whites 32, for negroes 19.2, and for total 27.3.

From the earliest days in the annual reports of the health department attention has been frequently directed to the enormous mortality from cholera infan-

TABLE 22.—*Number of deaths and the rate of death, per 100,000 living inhabitants under 2 years of age, from diarrhœa in children under 2, according to age, color, and sex, from 1910 to 1915, inclusive.**

D = death. R = rate.

TOTAL.

Year.	White.				Colored.			
	Male.		Female.		Male.		Female.	
	D	R	D	R	D	R	D	R
1910 ...	242	2727	204	2399	104	8374	70	5677
1911 ...	221	2467	235	2736	65	5179	62	5012
1912 ...	197	2178	193	2225	55	4338	65	5237
1913 ...	264	2890	208	2374	63	4918	54	4337
1914 ...	246	2667	220	2487	60	4637	45	3603
1915 ...	221	2373	171	1914	49	3749	33	2634
UNDER ONE YEAR.								
1910 ...	208	4634	165	3748	92	13431	62	9351
1911 ...	183	4037	205	4611	58	8382	54	8120
1912 ...	169	3692	156	3474	51	7296	58	8696
1913 ...	219	4739	183	4035	59	8357	45	6726
1914 ...	207	4436	185	4039	54	7574	40	5961
1915 ...	184	3906	137	2962	44	6111	27	4012
BETWEEN ONE AND TWO YEARS.								
1910 ...	34	776	39	951	12	2154	8	1404
1911 ...	38	858	30	724	7	1243	8	1399
1912 ...	28	626	37	885	4	703	7	1220
1913 ...	45	997	25	592	4	696	9	1563
1914 ...	39	856	35	820	6	1033	5	865
1915 ...	37	804	34	789	5	852	6	1034

* The totals of these figures, which were obtained from special tables in the annual reports, do not correspond with those given in the tables of deaths from all causes, but their proportionate distribution by color and sex may be regarded as relatively accurate.

The population figures used in computing rates for 1910 are those furnished by the Bureau of the Census. Owing to peculiar population changes in connection with the World War, the population figures used for 1911 to 1915, inclusive, were derived by exterpolation from the figures for 1910 rather than by interpolation from the figures for 1920.

tum, but except for recommending parks and the planting of shade trees, no recommendations were made until very recent years. While ever ready to cooperate with private agencies in furnishing statistical information, the health department has always confined its activities to general measures. The mortality of babies from cholera infantum in the larger foundling asylums was particularly heavy until the last few years. All effective efforts of a specific character to

TABLE 23.—*Number of deaths and monthly annual rate of death, per 100,000 living inhabitants under 2 years of age, from diarrhœa in children under 2, according to age, color, and sex, for 1910.**

D = death. R = rate.

Month.	Total.								Under 1 year.								Between 1 and 2 years.							
	White.				Colored.				White.				Colored.				White.				Colored.			
	Male.		Female.		Male.		Female.		Male.		Female.		Male.		Female.		Male.		Female.		Male.		Female.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
Jan.	4	1049	5	1337	...	.....	...	.....	1	269	2	574	...	.....	...	.....	5	663	7	969	...	.....	...	.....
Feb.	2	581	1	296	2	3806	1	1966	...	.....	1	318	...	.....	...	.....	2	294	2	307	2	2099	1	1057
Mar.	1	262	...	.....	2	3438	1	1776	...	.....	...	.....	1	2114	...	.....	1	133	...	.....	3	2844	1	955
Apr.	5	1355	3	829	2	3552	1	1835	...	.....	1	297	...	.....	...	.....	5	686	4	572	2	1959	1	987
May	4	1049	5	1337	1	1719	1	1776	1	269	1	287	...	.....	1	2066	5	663	6	831	1	948	2	1910
June	19	5150	10	2764	6	10657	9	16516	3	833	2	593	...	.....	3	6404	22	3017	12	1717	6	5878	12	11841
July	65	17049	57	15246	29	49846	15	26638	9	2417	8	2297	5	10569	1	2066	74	9819	65	9000	34	32232	16	15279
Aug.	46	12065	41	10966	27	46408	12	21310	6	1611	13	3732	2	4228	...	.....	52	6900	54	7477	29	27492	12	11459
Sept.	26	7047	21	5804	6	10657	11	20187	10	2775	6	1780	2	4369	2	4269	36	4936	27	3863	8	7837	13	12828
Oct.	25	6557	14	3745	9	15469	5	8879	3	806	3	861	2	4228	...	.....	28	3715	17	2354	11	10428	5	4775
Nov.	8	2168	7	1935	5	8881	4	7341	1	278	1	297	...	.....	1	2135	9	1234	8	1145	5	4898	5	4934
Dec.	3	787	1	267	3	5157	2	3552	...	.....	1	287	...	.....	...	.....	3	398	2	277	3	2844	2	1910
Total	208	4633	165	3748	92	13431	62	9351	34	776	39	951	12	2154	8	1404	242	2727	204	2399	104	8374	70	5677

* These figures were obtained from special tables in the annual reports and the totals do not correspond with those given in the table of deaths from all causes. However, the proportionate distribution by color and sex may be regarded as relatively accurate.

control the mortality from this disease have been executed by physicians and by certain private organizations. The medical profession has always insisted upon the importance of breast-feeding over the second summer if possible, and when this was impracticable upon the use of the best cow's milk procurable and properly modified. For both prevention and cure, removal of babies to the country was standard advice to mothers who could afford it. As early as 1870, William T. Howard, sr. (52), taught that babies weaned after April 1 rarely if ever escaped cholera infantum during the succeeding summer if kept in the city. While the public dispensaries and those connected with various hospitals had special services for children's diseases, the first organized pediatric clinic to undertake in a truly scientific manner the prevention and cure of infantile diarrhœa was that established in 1889 under the charge of Dr. William D. Booker, at the dispensary of the Johns Hopkins Hospital. Work on similar lines was soon undertaken at the Robert Garrett Hospital under the direction of Dr. Walter B. Platt, and at the Nursery and Children's Hospital by Drs. Friedenwald and Ruhrah. By 1900 the treatment of this disease had greatly improved at all the dispensaries with children's clinics. Booker was responsible for introducing the practice of pasteurization of milk for babies about 1892, the modification of cow's milk on scientific principles for infant feeding about 1895, and persuading Mr. Samuel M. Shoemaker to establish a Walker-Gordon milk laboratory to supply pure milk, both modified and whole in 1900.

The Thomas Wilson Sanatorium, the first endowed philanthropic institution in the city to contribute in a large way to the decrease in the death-rate from cholera infantum, opened its summer home in the country for babies ill with this disease in 1884. This institution has ever since favorably affected the official death-rate from cholera infantum, not only by preventing deaths among its patients, but by the fact that many children died there whose deaths would otherwise have occurred in the city. In addition to its other beneficent services and hardly of less importance, it afforded Booker, as director from 1884 to 1898, the necessary opportunity to pursue the studies and to gain the experience on which his qualifications for leadership were based. On Booker's pioneer work all real advances in the control of cholera infantum in Baltimore have been based. In 1904 the sanatorium established four milk stations in the city to provide good milk and nursing care for the babies. Milk modified in a number of simple mixtures by the Walker-Gordon laboratory was dispensed. By 1912 the Babies Milk Fund Association, which was organized in 1904 to operate these milk stations, substituted for the distribution of modified milk the practice of teaching mothers to modify milk in their homes. In addition a number of welfare clinics were established for the oversight of babies and the instruction of mothers in their feeding and general care. By 1918, 22 weekly clinics were held, and 22 nurses were employed. This year the medical directors, Dr. J. H. Mason Knox, jr. and Dr. Govan F. Powers, reported that of the 5,795 children under 3 years of age that were under observation at the clinics, only 36 or 0.6 per cent died of cholera infantum, and of the 4,700 children who received nursing supervision alone only 78 or 1.6 per cent died of this disease, while the rate for the remaining children of this age in the city was something less than 3 per cent. The disposition of mothers of certain race stocks to nurse their babies must have exerted a considerable influence upon cholera infantum;

while for the earlier years there is no definite information on this subject, inquiry has disclosed that mothers among some races of more recent immigration, i. e., Bohemians, Italians, Poles, and Polish Jews especially, with few exceptions nurse their babies faithfully and often over the second summer.

While cholera infantum or "summer complaint" of young children has been—though in the light of recent knowledge, probably erroneously—considered from time immemorial to be a single and specific disease entity, no such claim has been consistently made for the heterogeneous collection of acute intestinal affections so variously named as cholera morbus, cramp colic, and inflammation of the bowels, and finally classed together on the strength of a single symptom under the statistical nosological rubric (105), *diarrhœa in persons over 2 years of age.* In medical nosology it has long been recognized that these diarrhœas may be associated not only with poisonings with inorganic substances (arsenic, etc.), but with organic compounds present in foods—unripe and spoiled fruits and vegetables in common use, spoiled meats (including shellfish and other fish), spoiled milk and milk products, polluted waters, and particularly vegetables and fruits naturally poisonous to man (certain species of mushrooms, for example). The diarrhœas following the ingestion of spoiled food, attributed in the earlier days of bacteriology to special poisonous products produced by the action of the bacteria of putrefaction, were later ascribed partly or entirely to infections with specific bacteria (*B. enteritidis, B.paratyphosus, B. coli,* etc.). Similarly, the non-specific diarrhœas associated with drinking polluted waters and so common before the days of water purification have been attributed to bacteria, though the particular species of offending organisms have not by any means been satisfactorily identified. Infestion of the intestine by various species of worms has been long recognized as a cause of diarrhœa, and similarity in later years certain flagellate protozoa have been ascribed causal rôles. It is probable that in former days fatal diarrhœas due to unrecognized infestion with trichinæ were not uncommon. To ill-prepared and to scanty but otherwise healthy foods diarrhœas have often been attributed. Finally, there are diarrhœas believed, apparently with good reason, to be due to disorders of function of the nervous system, of which the so-called mucous colitis is an example.

Since the beginning of the local records, diarrhœal affections of adults and of older children, classified in both medical and statistical nosology as diarrhœa, inflammation of the bowels, cholera morbus, and cramp colic, have been credited with a considerable toll of deaths. As has already been indicated, it is certain that until very recently due discrimination was not exercised in the classification of deaths between these categories and cholera infantum. An error in a way even more serious has doubtless arisen from the classification under these headings of deaths due to such specific diseases as Asiatic or true cholera, dysentery, typhoid fever, tuberculosis (pulmonary and intestinal, both often associated with looseness of the bowels), paratyphoid fever, and appendicitis.

Diarrhœa occupied a position in the statistical nosology as early as 1812, but did not appear again until 1820. With the exception of 1821, 1822, and 1825, it was not credited with any considerable number of deaths until 1849, and in many of the intervening years was entirely absent from the list of the causes of death. Indeed, it was not until 1875 that this term was given constantly and

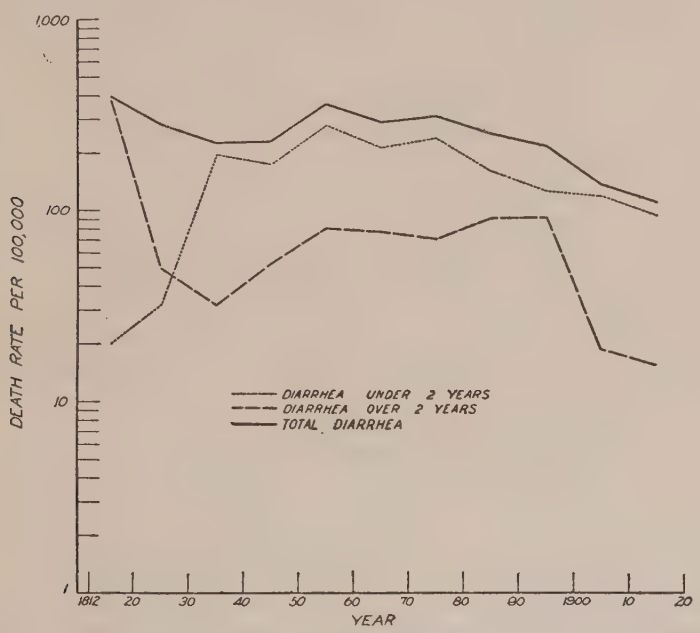
consecutively the leading position in the statistical nosology for deaths from this group of affections. Inflammation of the bowels, though introduced in the statistical nosology as early as 1818, did not attain importance until 20 years later. During the fifth, sixth, and seventh decades of the nineteenth century it was a favorite rubric, and average rates of 30 or over were recorded. From 1871 to 1895 the averaged rates were about 18; and, with gradually diminishing rates, it disappeared in 1899. The rates under this rubric were but little influenced by the cholera years. Cramp colic, appearing in the list of causes of death in 1812, and the accredited cause of a considerable number of deaths in the second, third, and seventh decades of the nineteenth century, was dropped from the statistical nosology in 1873. Cholera morbus appeared as a statistical rubric from 1812 until 1913, but until 1821 carried also the deaths from cholera infantum. During much of the period until 1873 it was credited with relatively high rates. As elsewhere pointed out, the rates for this rubric were particularly high in certain cholera years (1834, 1849, and 1854). The relative importance at different periods of these four categories—diarrhœa, inflammation of the bowels, cramp colic, and cholera morbus—is shown in table 19.

The course of the curve of the annual mortality rates for this group of affections embraced is the rubric diarrhœa (105) shows considerable fluctuation (graph 5), sometimes from year to year and at other times over longer or shorter terms of years. The rise and fall in the rates vary sometimes directly, or in the same direction, and at other times indirectly, or the direction opposite with those of cholera infantum and of dysentery. As compared with dysentery, with few exceptions, not until 1850 do high and low rates for the two rubrics fall in the same years. It is not until the epidemic wave of dysentery beginning in 1849 that the courses of these two affections really move closely together. When dysentery fell abruptly 10 years later diarrhœa did not follow. The same phenomenon occurred in connection with the last dysentery epidemic, 1886–1890. On the whole, however, the rates for the two show a decided tendency to follow the same course. The toll of mortality has been generally much greater for diarrhœa than for dysentery. The correspondences and differences between the courses of the rates for cholera infantum and diarrhœa have already been dwelt upon at some length. The decided effect of cholera upon the rates for diarrhœa is apparent in 1832, 1834, 1849, and 1854.

At the beginning of the period, though the rates for diarrhœa were in general lower than later on, their annual fluctuations were wider and years of high rates were commonly succeeded by one or more years of low rates. Between 1835 and 1841 the annual rates were consistently low; they rose gradually until 1849, and between the latter date and 1898 they were never below 50 and rarely below 60. The highest rate recorded was 182 in 1854 (a cholera year). The abrupt fall to 36 in 1899 in the rate which had been maintained for 12 years at over 100, occurring in the absence of any ascertainable changes in population composition, legislation, general sanitary environment, or administrative activity, was probably due to changes in classification of deaths as between cholera infantum and diarrhœa and to the elimination from the statistical nosology of inflammation of the bowels. The latter heading, once so important, but for the previous 20 years attended by rates between 12 and 18, had probably

in the last two decades of the nineteenth century carried deaths from appendicitis and typhilitis, and for that period at least a rate of from 12 to 15 could with propriety on this account be subtracted from the rates for the rubric diarrhœa.

Thus, it is evident that the figures recorded for deaths under the headings embraced in the rubric diarrhœa can not be regarded as even approaching accuracy, for they are subject not only to errors of classification as between diarrhœa and cholera infantum, but include certainly in some years deaths from cholera and probably in many years deaths from other affections, notably dysentery (particularly amœbic), typhoid fever, and appendicitis.



GRAPH 7 (from table 20). Crude mortality rates from diarrhœa, averaged by 10-year periods, from 1812 to 1920, inclusive.

The curves for the rates for diarrhœa averaged for 5- and 10-year periods table 20, graphs 6 and 7) give perhaps a clearer picture of the course of the mortality of this group of affections. The rates as averaged for 5 years show a gradual descent from 55 in 1821–1825 to 21 in 1836–1840. During the next 15 years by gradual steps these rates rose to 100 in 1851–1855 but receded to 62 in 1856–1860. The rates rose during the following 10 years to a second peak in 1866–1870 with a rate of 88. A descent in the rates to 70 by 1876–1880 was a prelude to an uninterrupted ascent to the highest averaged rates attained at all, 109, for the quinquennium ending in 1895. Ten years later these averaged rates had fallen to 17, a figure departed from but slightly during the remaining 15 years. The rates averaged for 10-year periods show the same fall between 1821 and 1840 with a succeeding rise to 81 in 1851–1860, a level maintained during the following 10 years. The moderate fall shown in the rates averaged

for the 10-year period 1871–1880 was succeeded by a second rise maintained at 92 for the 20 years 1881–1900. The sharp fall during the last 20 years parallels that shown in the quinquennial rates. A striking parallel between the courses of these two curves and those of cholera infantum exists up to 1880, but between this date and 1900 the former rose while the latter fell, and during the 20 years 1901–1920 the fall for diarrhœa was much more abrupt than that for cholera infantum. The divergent courses of these curves after 1880 was probably due, as previously explained, more largely to changes in the classification of deaths as between those two rubrics than to actual variations in their respective rates of mortality.

It is especially worthy of note that the averaged rates for the quinquennial periods ending in 1840 and 1910 were identical, i. e., 21, and that in each case the low point was attained after a prolonged era of exceptionally high rates, in the last instance covering a period of 60 years. Considered from this viewpoint, diarrhœa, like cholera infantum, presents strong evidence of having run a course of two sharply defined cycles. The first, beginning perhaps long before the date of this record (1812), is viewed only in its period of decline, which covered at least the 20 years 1821 to 1840. The second cycle, ranging over a period of 70 years, 1841 to 1910, is in full view. It takes the form of a prolonged single wave of high death-rates, broken at intervals of from 15 to 20 years by three minor or subsidiary waves, with the rise and fall of the major wave almost equally abrupt.

Data for the influence of color, sex, and age upon the mortality morbidity for diarrhœa are lacking. The distribution of deaths according to season agrees with that for cholera infantum.

The prevalence and serious menace of diarrhœa (105) were never alluded to in the reports of the health department.

The field having been cleared in this preliminary consideration of the two statistical subdivisions of the diarrhœal affections, the study of the force of mortality of this group as a whole upon the population may be undertaken.

By combining the rates for cholera infantum and diarrhœa (tables 19 and 20, graphs 5, 6, and 7) the inaccuracies incident in both divisors and dividends and in classification inherent in calculating rates for these causes separately are largely though not entirely overcome. Omitting as unnecessary detailed description of the courses of the curves for annual rates and for rates averaged for 5- and 10-year periods, and confining consideration to a broad view, certain important features stand out with distinctness. They may be summarized as follows:

On the whole, and particularly up to 1880, the course of the curves is determined by cholera infantum.

Since 1812 the curves describe two long waves, the first extending from an unknown date to about 1845 and the second running from the latter date to about 1900.

The highest averaged rates and the highest annual rate occurred during the peak of the first wave and before 1820.

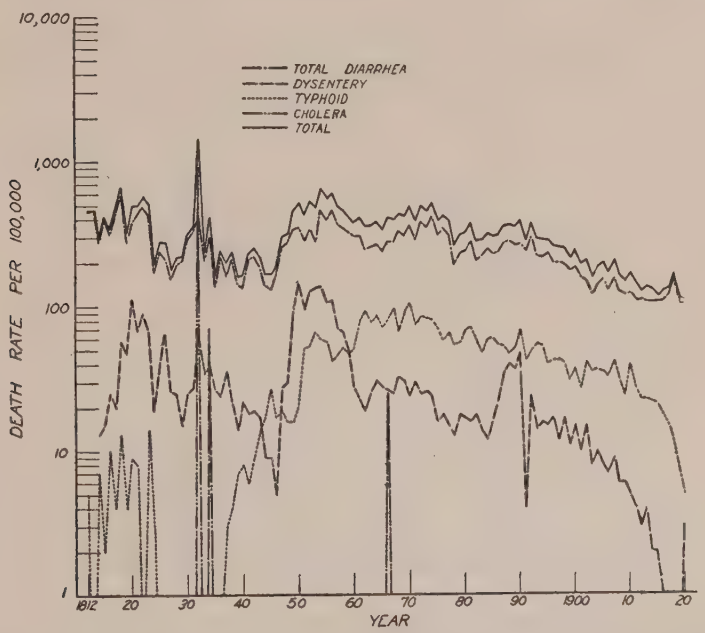
The second wave reached its peak (about 1860) within the first 15 years of the 55 years of its duration. Its decline was slow and hesitating until after 1890.

About 1900, the course of mortality, having reached approximately the same low level it had attained in 1845, failed to run into a third wave, but, contrary to previous experience, it continued to decline to a lower level than ever before registered and during the past 10 years has shown a tendency to stabilize around a rate of 100.

From the position of high importance occupied during most of the period between 1812 and 1825 and between 1850 and 1870, the affections under consideration became relatively unimportant causes of death by 1915.

DYSENTERY.

While the course of dysentery has been marked by rather wide fluctuations (table 19, graph 8) since its appearance in the local statistical nosology in

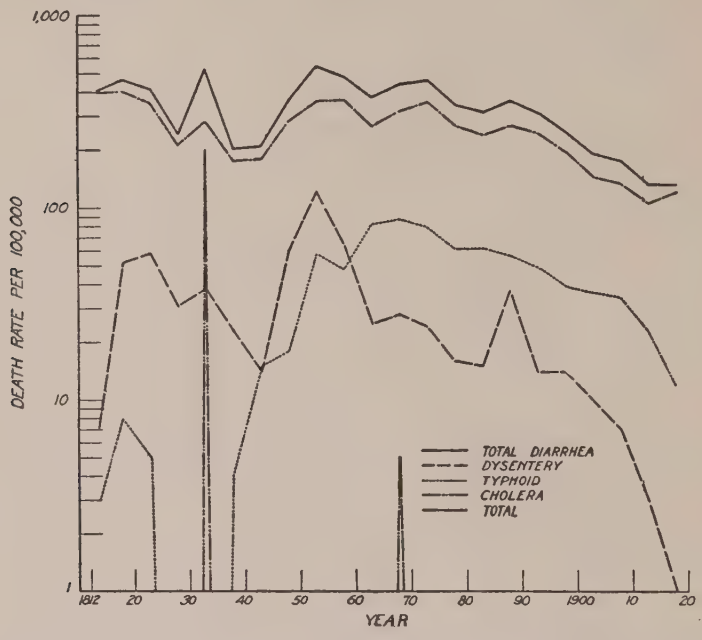


GRAPH 8 (from table 19). Annual crude mortality rates from diarrhœa, dysentery, asiatic cholera, and typhoid fever, from 1812 to 1920, inclusive.

1814, the variations from year to year have not, in general, been great. Much more characteristic has been the occurrence of epidemic waves appearing from time to time, in which, from a comparatively low basic level, the rates have ascended sharply, usually by uneven steps, during 3 or 4 years, to a peak, to fall again, often in the same irregular fashion.

Study of the annual rates discloses six distinct waves of mortality. The first wave, starting in 1815 and ending in 1824, rose sharply, but with several remissions, to a peak in 1820 (111) from which it receded to a low level in 1824 with a rate (19) but very little above that of 1814. The peak (with a rate of 64) of the second wave, a very short one, was attained in 1826, and the succeeding rapid decline reached its low point (12) in 1829. The third wave,

with its peak in 1832 (58), receded slowly and irregularly to the lowest level (5), yet observed in 1846. The fourth wave, beginning in 1847 and attaining in 1850 the highest level of mortality (145), in the history of the disease and declining sharply in 1851, reacted in 1852–1854 with rates of 128, 136, and 137, respectively. It then turned to reach by hesitating steps the low point of 19 in 1862. The fifth wave, quite different in its course from its predecessors, began in 1863, attaining rates around 30 in only 4 of the succeeding 8 years, and declined gradually to the low level of 12 in 1884. The sixth and last wave, occupying the years between 1885 and 1920, attained its peak of 49 in 1890, and after a sharp recession to a rate of 4 in 1891 and an abrupt rise to 24 in 1892, it gradually declined. Since 1910 the mortality from dysentery has



GRAPH 9 (from table 20). Crude mortality rates from diarrhœa, dysentery, asiatic cholera, and typhoid fever, averaged by 5-year periods, from 1812 to 1920, inclusive.

been almost negligible. Years of conspicuously high death-rates were 1820 (97), 1850 (145), 1852 (128), 1853 (136), and 1854 (138). The fourth wave, as measured by the height of rates registered and the number of years during which high rates were maintained, was by far the most severe.

Turning now to the rates averaged for 5-year periods (table 20, graph 9), three major epidemic periods (1815–1845, 1850–1880, 1885–1895), with their peaks falling in the quinquennial periods ending in 1825, 1855, and 1890, stand out with distinctness. The descent in the curve of both the first and second of these waves is broken by a secondary rise. The stationary state of the averaged rates as recorded between 1876–1880 and 1881–1885, and 1891–1895 and 1896–1900 at about the same low level reached in 1841–1845 is

significant. Three waves appear in the course of the curve of the rates as averaged for 10-year periods. The first wave, with an average rate of 32 for the period ending in 1820 and 44 for the next 10 years, had receded to 31 by 1840. The second wave, with its slight rise in the rates between 1841 and 1850, reached its high peak in 1851–1860 (93) and receded to 27 in 1861–1870. The third wave, reaching abruptly its peak in 1881-1890, declined even more sharply.

On analysis of the curves for the annual rates averaged for 5- and 10-year periods, certain striking facts in the natural history of dysentery in Baltimore come to light. During the 20 years from 1816 to 1835 it was responsible for a considerable mortality, but during the next 10 years it lost so greatly in force that it might well have died out. Due to the interpolation of some cause or causes beginning to act between 1847 and 1850, the diseases rapidly assumed a more important rôle than ever before, and between 1850 and 1865 it exhibited an unprecedented virulence. This phase had entirely subsided by 1885, and but for a final flare-up between 1887 and 1892, the disease was well started on its gradual decline to well-nigh extinction.

The whole course of the disease during 106 years for which it can be followed, suggests that, while securely intrenched and able to retain perennially a secure foothold, from time to time conditions arose that permitted epidemic outbreaks that ran very definite wave-like courses. Under usual conditions the tendency seems to have been to relatively low rates of mortality.

The influence of season upon the death-rates from dysentery has been striking. Davidge, Reese, Potter, and others have recorded that dysentery was common and fatal at Fell's Point in the summertime during the last years of the eighteenth and the early years of the nineteenth century. The monthly distribution of the deaths from dysentery given in the tables of the annual reports since 1860 shows that while in many years death occurred in every month, the greater number always occurred in the summer months.

Concerning the relative frequency of the two chief varieties of dysentery, the bacillary and the amœbic, there are no data before 1890, when the amœbic type, so distinctive also in its anatomical lesions, was first recognized. Though a considerable proportion of the earlier cases studied by Councilman and Lafleur (57), in 1890 and 1891 originated elsewhere, in Panama, at sea, in Sparrows Point near Baltimore, and in the counties of Maryland, a large moiety of the cases had never been out of the city. A certain number of these cases were in stevedores who worked and lived near the harbor. Later it was observed, chiefly by physicians associated with the Johns Hopkins Hospital, that amœbic dysentery was by no means uncommon among residents of Baltimore and other parts of Maryland. There is no evidence, however, that this variety of dysentery formed a conspicuous proportion of the dysenteries during the last epidemic wave, the peak of which was in 1890. Amœbic dysentery has been comparatively rare in the city since 1900. Since this date, at least, it seems to have given place to the bacillary type. From the coincidence of very fatal malaria, yellow fever, and dysentery, particularly at Fell's Point, during the last years of the eighteenth and the beginning of the nineteenth century, with extensive shipping trade with the tropics, it is very probable that amœbic dysentery was prevalent at that time and never died out. It is more likely,

however, that in the earlier great waves of dysentery, and particularly that between 1850 and 1870, the bacillary type was predominant. At least, during this period, there existed abundant opportunities for its importation. However, as both types of the disease are met with in temperate as well as tropical climates, and conditions were favorable for the importation and propagation of their causal agents, in the absence of exact studies in etiology and pathological anatomy, no definite conclusion can be arrived at in regard to their relative frequency as a cause of death. In 1850, at the height of the second wave of dysentery, according to Frick's analysis, the disease was nearly "four times more fatal among the whites than the blacks, the numbers being for the first 16 to the 10,000 inhabitants, and only 4.6 for the latter." As between the sexes the distribution of fatalities were 59 per cent among males and 41 per cent among females; 90 per cent of the whole number of deaths occurred in July, August, and September.

TABLE 24.—*Number of deaths and rate of death, per 100,000 living inhabitants, from dysentery, according to age, 1850.*

Age periods.	Deaths.	Rate.
Under 1 year	31	506
1 to 4 years	70	380
5 to 9 years	38	189
0 to 9 years	139	312
10 to 19 years	25	68
20 to 29 years	19	55
30 to 39 years	20	81
40 to 49 years	9	62
50 to 59 years	10	123
60 years and over	15	236
Total	237	79

Mortality rates specific for age calculated from Frick's figures are given in table 24. It will be noted that the highest rates occurred at the extremes of life, 312 under the tenth and 236 over the sixtieth year. The excessively high rate of 506 for the first year of life is striking, and supports the opinion elsewhere advanced that an intimate relation has existed between dysentery and cholera infantum in Baltimore. As regards seasonal distribution, the mortality from dysentery has not departed significantly in late years from Frick's findings. The reports of the health department do not furnish data for estimating the influence of age, sex, and color upon dysentery mortality in recent years. Morbidity reports are completely lacking.

CHOLERA.

According to the official records, true cholera has been present in Baltimore in the 7 years 1832, 1834, 1845, 1866, 1877, and 1879 (table 19, graph 8). It will be noted that this disease was not recognized as present in any two consecutive years. This and other evidence at hand supports the view that it rarely, if ever, gained endemic foothold, but was newly imported in each year

in which it occurred. However, in 1833 and in 1867, each immediately succeeding a year of serious epidemic prevalence of the disease, the number of deaths ascribed to the common indigenous diarrhœal diseases (cholera morbus, cramp colic, and cholera infantum) was decidedly greater than the average for these categories. On the other hand, as the same phenomenon commonly occurred during years when cholera was acknowledged to be present, it was probably due to conscious or unconscious faults of diagnosis and classification, and in these particular years the hidden cholera present was probably the result of new importation rather than the survival of the disease over the cold weather. However this may be, cholera in Baltimore has been a fortuitous visitant, and always a reflection of the invasion of the disease to western Europe and thence to America.

From the known history of the affection in Baltimore, it is clear that while in each of the great pandemics the disease reached the city, only once, i. e., in 1832, did the environmental conditions favorable to its general dissemination and the chance distribution and propagation of its causal agent so fall together that epidemic outbreak on a great scale occurred. As the environmental conditions (ready pollution of at least a part of the water-supply—wells and springs—and access of myriads of flies to intestinal discharges and to food) were in those times particularly favorable, it would appear that the city's relatively slight outbreaks in most cholera years were due very largely to lucky chance. From the comparatively full accounts given in the annual reports of the years of serious epidemics and the more circumstantial records of Jameson (49) and T. H. Buckler (11), it is possible to trace the history of cholera in Baltimore with some degree of exactness. That a visitation of cholera was inevitable was apparent to Dr. Jameson, the consulting physician of the board of health, early in 1832. In his youth he had imbibed from his father, a physician trained in Edinburgh, the Sydenham doctrine of the causal relation of "atmospheric constitutions" to epidemic diseases in general, and this doctrine dominated his thought and activities throughout his public-health career. Having followed closely, through private correspondence and the public prints, the course of cholera in Europe in 1830 and 1831, by February 1832, he was convinced that the disease was no exception to this general law. He, therefore, informed the mayor and board of health that, in his opinion, cholera was neither importable nor contagious, but was caused by a peculiar epidemic constitution of the atmosphere. Consequently, he held that the one thing of prime importance was to thoroughly clear the city of everything that might contaminate the atmosphere. To his mind quarantine, isolation, and compulsory hospitalization, as so generally advocated and practiced, were useless and wasteful of money and effort. He suggested the establishment of dispensaries conveniently situated for the early treatment of the poor with symptoms of cholera. For personal prophylaxis, he advised temperance and restriction of diet, with the avoidance of fresh fruits and vegetables. Jameson's views were accepted by the mayor and the board of health and all the measures contrary to them that were undertaken were adopted by an unwilling administration, to whom, in Jameson's words, "prudence dictated the propriety of deferring to the wishes of the people." On the other hand, the great mass of the people were convinced that cholera was both importable and highly contagious, and on June 7, when the ship

Brenda arrived from Liverpool after losing 14 out of her 123 passengers from cholera during her 42 days passage, they voiced the conviction in no uncertain terms. The ship, though then free from cholera cases, was held at the lazaretto for the usual ventilation of baggage and cargo, and the passengers were detained under observation for several days. On June 26 an ordinance was passed which required stringent quarantine of both persons and ships arriving from foreign and domestic ports where dangerous contagious disease existed. Persons were forbidden entry to Baltimore within 14 days of their arrival from any foreign country. Jameson afterwards justified his own opinion by pointing out that among the 11,946 passengers arriving at quarantine between May and November not a solitary case of cholera was detected.

By July, cholera was rapidly making its way towards Baltimore from the north and west, and on the 7th, by ordinance, the means and personnel were provided for more thorough cleaning of the streets and alleys, vacant lots, stables, hogpens, slaughterhouses, and other sources of nuisances, and for repaving and flushing the street gutters and the liming of all cesspools and privies. The board of health was authorized to take over and equip properly for cholera patients the Maryland Hospital and as many private dwellings as might seem necessary and to appoint an apothecary in each ward to furnish medicines at all hours at the city's expense to cholera patients.

Considerable headway was made in cleaning up the city in the 5 weeks that elapsed before the first cases of cholera were recognized. From Jameson's account it appears that his influence with the mayor was sufficient to limit the number of cholera hospitals to three. To one of these he attached a free dispensary. In addition to the ward apothecaries, a physician was appointed in each of the 12 wards for the free treatment of the poor.

As so often happens in epidemic visitations, the earliest cases were not recognized. On August 4, a girl of 7 years, who lived at the corner of Baltimore and Liberty streets, in one of the best sections of the city, died suddenly of an affection which was later considered to be cholera. The death of an old man on the same day and the death several days later of a boy were afterwards thought by Jameson to have been caused by cholera.

At a meeting of physicians called by the mayor on August 9, while it was reported that diarrhœa was common, but few of those present acknowledged that they had seen "cases having the aspect of cholera in its intense stage." Dr. Jameson reported that he had seen cases of true cholera with one death at one of the hospitals, and at his instance a resolution was passed declaring that cholera was present in the city. On August 13, 12 deaths occurred from cholera, and of these 10 were in negroes living in Ruxton Lane or its neighborhood. On the 20th, 55 cases were reported.

From table 25 the course of this disease as expressed by deaths may be followed by weeks. It will be noted that the number of weekly deaths ascribed both to cholera and to all causes rose steadily to a peak reached the week ending September 10 and that the decline was rapid and striking during the next 4 weeks. The disease about held its own between October 10 and 16. The number of deaths from cholera during the third week of October was double that recorded in the second week. After falling during the last week of October to the level reached for the second week of this month, the number of deaths rose

again during the first week of November. After November 5, however, there were but 2 cholera deaths. The greater number of cholera deaths (seven-eighths) occurred in September, and one-seventh of the whole number was recorded in the 7 days between the 4th and the 10th of this month. From this table it is evident that the number of deaths from all causes, while rising and falling directly with the cholera deaths, was, during August, September, and October, relatively much greater than accounted for by the deaths attributed to cholera. During September, for instance, the number of deaths ascribed to causes other than cholera was nearly double the ordinary number of deaths for this month. It would appear, then, that the full influence of cholera upon the mortality during the epidemic is not disclosed by the official figures of cholera deaths.

TABLE 25.—*Number of deaths and weekly annual rate of death, per 100,000 living inhabitants, from cholera and all causes, during the period of the cholera epidemic in 1832.*

Week ending.	Cholera.		All causes.	
	Deaths.	Rate.	Deaths.	Rate.
Aug. 14.....	12	679	79	4471
20.....	54	3056	127	7187
27.....	121	6848	178	10074
Sept. 3.....	170	9621	254	14375
10.....	226	12790	332	18789
17.....	135	7640	225	12733
24.....	40	2264	116	6565
Oct. 1.....	21	1188	89	5037
9.....	12	679	68	3848
16.....	10	566	52	2943
23.....	25	1415	82	4641
30.....	10	566	62	3509
Nov. 5.....	15	849	66	3735
13.....	1	57	34	1924
20.....	1	57	34	1924
27.....	...	...	44	2490
Total ..	853	926	1842	1999

It has been pointed out at the beginning of this study that during 1832 the death-rates for diarrhœa (105) and cholera infantum (104) were unusually high. The 4 deaths from cholera already mentioned as occurring early in August were not included in the 853 deaths officially credited to cholera, and there were doubtless many others in the same category. On a conservative estimate, considerably more than 1 per cent of the total population died of cholera in this year.

Cholera attacked 211 of the 502 inmates of the almshouse, and of these 133 died. As the almshouse was situated without the city limits, these deaths were not included in the official figures.

The records throw no light upon how the disease gained entrance to the city. Whether or not cases or carriers were admitted through shipping can not now be decided. At any rate, there is little doubt that the disease was introduced

by means of overland communication from the north and west, where it was first prevalent, and for which abundant opportunity was open.

The first openly declared cases appeared in Ruxton Lane, now Balderston Street, a narrow and filthy alley, a short distance southeast of Baltimore and Liberty streets and in the direct line of natural drainage from the latter point, where resided the girl who died on August 4 of what Dr. Jameson afterwards regarded as cholera. Ruxton Lane was but a short distance from Clopton's Spring, one of the favorite public springs. It is not unlikely that this spring was polluted early in the epidemic and was responsible, if not for the Ruxton Lane cases, at least for the numerous cases which, according to Jameson, later occurred along Liberty Street and its vicinity. The disease subsequently spread through most of the city. In some places crowded streets and alleys suffered most, but there were many exceptions to this. From the character of the epidemic, as judged by the time distribution of the deaths and from Jameson's allusion to the gradual spread of the disease through the city, it would seem likely that its chief means of dissemination was by means of the wells and public springs, which perhaps became polluted in rotation as the infective agent was carried from one part of the city to another by persons infected in other localities. It is quite possible that the external water-supply may have been infected for a time at least. There was, of course, ample opportunity for spread of the diseases by means of flies, which must have existed in great numbers. As much of the milk-supply was derived from cows kept within the city, opportunities for the infection of this article of food were peculiarly favorable.

There is no record of the whole number of cases reported, nor are there data regarding the influence of age, sex, and color upon either incidence or mortality. According to Jameson, "a very great majority of those who died were of the most worthless; but a few of our respectable citizens fell victims . . . . ," a blunt way of saying that the disease was more prevalent and fatal among the poor and ill-nourished than among the well-to-do.

Out of the nearly 100 physicians of the city, a few had the disease and one died. From this it would appear that the mortality rate among physicians was about the same as that for the population as a whole. Two out of an unknown number of Catholic sisters, who acted as voluntary nurses in cholera hospitals, died of the disease. Of the 387 cases admitted to the cholera hospitals, 170 died, a case fatality-rate of 44 per cent. However, as it is recorded that many were moribund on admission and that such was the dread of the hospitals that few who had homes and could receive any attention in them would consent to be removed, these figures can not be taken as a correct index of the proportion of cases to deaths in the whole population.

From Jameson's account, the plan of medical treatment of the hospital cases—copious blood letting, purging with calomel and aloes and croton and castor oils, blistering with cantharides, and the like, was not calculated to diminish the fatality rate. It is of interest that following the lead of Diffenbach, of Berlin, and of certain physicians of New York and of Norfolk, Virginia, Jameson experimented with intravenous injections of common salt and water. While temporary improvement followed in some cases, all patients so treated died. His experience with injections of plain water and aqueous solution of nitrate of potash was similar.

The data concerning the cholera of 1834 are very scanty. Jameson recorded that a few doubtful cases occurred in the summer, but that in November there was a sudden outbreak. During this month there occurred 71 deaths, the whole number recorded for this year. The cholera hospital was opened on November 8 and closed on December 6. As Jameson regarded the doubtful cases of the summer, as well as those of November, as cases of cholera morbus or "consecutive cholera . . . . made to assume the livery of cholera from a predisposition or impression left in the system by the epidemic atmosphere of 1832," and as rates for diarrhœa and cholera infantum jumped, as in 1832, to unusually high levels, there is good reason for the inference that cholera was much more widespread and fatal in 1834 than the official figures indicate.

The correctness of the diagnosis in connection with the single death ascribed to cholera in 1845 is open to question. No mention was made in the annual report of the presence of this disease in the city or at the quarantine station, and there was no significant change in the rates for the diarrhœal affections.

Cholera was undoubtedly prevalent to some extent within the city in 1849, though no deaths were credited to it, and no allusion was made to the disease in the annual report of the health department.

T. H. Buckler (11) wrote a very complete account of a serious epidemic of cholera at the almshouse in 1849. The first case occurred on July 1 and the last on August 8; the first death took place on July 11 and the last on August 5. During the first two weeks the progress of the disease was slow and hesitating (single cases on July 1 and 7, 3 each on the 11th and 12th, and 1 case on the 13th). The peak came abruptly and lasted 10 days with relatively little daily variation in the number of cases (13 cases on the 14th and a daily average of 10 new cases from the 15th to the 24th). The decline was as sharp and as long drawn out as the approach (3 cases on the 25th and, with the exception of 4 cases on the 27th and 5 on the 30th, never more than 3 a day, and a total of 8 cases between August 1 and 8). The distribution of deaths according to days followed that of the cases very closely during the height of the epidemic.

The population of the almshouse when cholera broke out was 560, of whom 407 were whites and 153 blacks; but during the epidemic there were 109 admissions and 153 emissions. The latter embraced 56 discharges, 76 elopements, and 21 dead from causes other than cholera. Altogether, 669 individuals were exposed to risk of attack and death from cholera, but their degree of exposure was not the same. On this account it is not possible to calculate precise morbidity and mortality rates. There were recognized 155 cases of true cholera; of these 86 died, and on the basis of a population of 669 exposed in some degree, the attack and mortality rates were 23 per cent and 12.8 per cent respectively. Among the whites there were 112 cases with 57 deaths and among the negroes 43 cases with 29 deaths; thus the case fatality rates were: Whites 50 per cent, negroes 67 per cent, total 55.5 per cent. However, according to Buckler, the number of each sex admitted, discharged, and eloped during July bore a very uniform ratio to the proportion of males and females present at the beginning of the month. On the female side of the institution there were on July 1, 322, and in this department 62 had cholera and 38 died; the males at the same date numbered 238, and on this side there were 93 cases of cholera,

with 48 deaths. Using these figures as a basis, the attack, death, and case-fatality rates were: For females 19 per cent, 11 per cent and 61 per cent, and for males 39 per cent, 20 per cent, and 50 per cent, respectively. According to these approximate figures, the attack and death rates were twice as great in males as in females, and the case fatality was somewhat higher in females than in males.

As from Buckler's account it is probable that the infection was not spread by the water-supply derived from a nearby stream called Rutter's Run, at a point above the institution, but rather by personal contact and by flies, since the disease was not uniformly distributed throughout the institution and the great bulk of the cases developed among those who were housed in the wings facing north and east and directly overlooking a huge open cesspool which received all the drainage. Draining and cleaning the cesspool by ditching and flushing was started on July 23 and finished on the 25th, the date of the beginning of the decline in the attack rate. Three days later the whole area of this pond of fecal discharge was covered with several bushels of unslaked lime overlayed with fresh earth, and after July 28 only 18 additional cases occurred. Two of the three laborers employed in this work developed cholera on July 29 at their homes in the city. According to the fashion of the day, Buckler attributed the outbreak to miasma from the open cesspool.

Though not officially recognized, cholera was certainly present in the city during this year. Besides the two laborers above mentioned, Buckler saw 3 cases late in July and on September 15 attended another case in a man who was taken sick shortly after arriving from Cincinnati. According to him, a mild "cholorine" prevailed during the summer in nearly every section of the city. Though no deaths were recorded from cholera, the death rates from diarrhœa and cholera infantum were conspicuously higher than during the previous year.

No cases of cholera were discovered on ships arriving at quarantine. It is certain that the disease was brought in by overland travelers at least once during the year, and it is probable that sporadic cases secondary to imported cases occurred widely during the hot weather. The disease was probably introduced into the almshouse by a pauper from the city. That the city escaped a widespread water-borne epidemic is due to the fact that Rutter's Run, into which the almshouse cesspool drained, was a tributary of Gwynn's and not of Jones Falls.

In 1854, a few sporadic cases of cholera, with 2 deaths, were acknowledged by the health department. These were regarded as secondary to a small outbreak just without the western border of the city. One case of cholera was recorded at the Marine Hospital, but this was possibly received from the city. In this year not only were deaths from the diarrhœal diseases considerably higher than during the preceding year, but the increase was most marked in the categories most likely to hide cholera, namely, cholera morbus and cramp colic. In 1854, the deaths from the former were 129 and from the latter 111, in contrast to 11 and 28, respectively, in 1853. The total rate for diarrhœa was 182, or more than double the rates for 1853 and 1855. There is ample reason, therefore, for the inference that cholera was epidemic in the city in 1854 and was responsible for a death-rate of at least 100.

Judging from the monthly distribution of the recorded deaths from the disease, 54 in October and 6 in November, the outbreak of recognized cholera in 1866 probably began after the middle of September. It is unlikely, however, that this disease was more widely spread and fatal than the official figures indicate, for the death-rates from both cholera infantum and diarrhœa were not significantly higher than in the years immediately preceding. Though cholera approached the city by water, a case being removed from a vessel at quarantine during the summer, the health authorities were perhaps correct in their assertion that the first cases came overland, one from New York and the other from Cincinnati. Their attitude towards the disease was quite different now. Theories of "atmospheric constitutions" and of miasma no longer befogged their minds. Snow's discovery of some 16 years before that epidemic cholera was largely waterborne, and the popular view that the disease might be conveyed somehow by personal relation with cholera patients, were taken seriously. Action direct and personal became the order of the day; the sick and their discharges, clothing, and utensils were recognized as vehicles by which the mysterious cause was disseminated. Measures were adopted to secure the removal and destruction of everything used by those affected with the disease, and the disinfection and burial of their discharges. In appropriate instances both the sick and the exposed were removed to the quarantine hospital.

"In Elbow Lane, in one square, 20 cases occurred in 2 days; the crowded conditions of the houses, the filth of the houses and of the people (negroes) we thought justified extreme measures. Every person, both sick and well, was removed to the quarantine grounds, the sick put in the hospital and the others in barracks. Not a single case occurred after removal, either in the alley or in the removed persons. But one of those attacked recovered."

Everything used by the sick was destroyed, the houses were fumigated, and after 10 days the well people were allowed to return; no subsequent cases occurred in this group.

No allusion is made to cholera in the annual reports for 1877 and 1879. From the comparatively small number of deaths and the absence of any striking increase in the rates from diarrhœa and cholera infantum, it is probable that the disease was confined to a few sporadic cases. No cases were discovered in connection with shipping.

Unfortunately, for none of the cholera years is there any record of the number of cases or of the distribution of the deaths according to the age, sex, or color of the decedents.

Thus runs the history of cholera in Baltimore. Though incomplete in many details, it is sufficiently accurate for a fairly correct picture. Attention may here be directed to certain points of particular importance. While the official figures of deaths ascribed to cholera are probably lower than the actual number of deaths from this disease in every year in which cholera occurred, they are particularly far short of the truth for 1849 and 1854. In these two years, at least, the health authorities deliberately sought to hide the truth. The great influence of cholera in 1832 and 1834 upon the total death-rate from acute intestinal diseases for the quinquennium 1831–1835 and the decennium 1831–1840 is shown by the fact that by the official figures alone the cholera deaths raised the averaged rates for the former period by 200 and for the latter period by 100. If, for the period, 1831–1835, all the deaths really due to cholera but

which were credited to cholera infantum and diarrhœa could be properly classified, it would appear that, but for the advent of cholera, the decline in the total rate for the acute intestinal diseases would have been unbroken. As it is, when the rates for cholera calculated from the official figures, without such allowance, are subtracted from the rates averaged for the 10 years 1831–1840, the decline in the curve is almost continuous. Similarly, a not inconsiderable portion of the ascent in the total rates for acute intestinal affections between 1849 and 1860 was due to the influence of cholera in 1849 and 1854.

On the whole, in comparison with certain other cities, Baltimore's experience with cholera was not unlucky. In but one year, 1832, was the toll from cholera relatively serious.

TYPHOID FEVER.

The term *typhoid fever* did not appear in the local statistical nosology until 1851. However, there is convincing evidence that the disease was not uncommon in the city long before this date. The report of the attending physicians of the almshouse infirmary in 1828 mentions 58 cases of *febris typhoides,* with 13 deaths. Typhoid fever was credited in these reports with cases and deaths every year but one between 1833 and 1849, and during these 17 years there was a total of 359 cases with 106 deaths. E. Geddings (58), under the title of "gastric, or more properly intestinal fever," described a continuous fever of grave type which was very prevalent in 1834; 80 casese were admitted to the Baltimore Infirmary during the summer of this year. It was especially common at Fell's Point, and many of the patients were sailors who were attacked after their arrival. Some of the victims were brought in from the nearby rural districts. From Gedding's description of the clinical symptoms and of the ulcers of the small intestine in fatal cases, there can be little doubt that he was dealing with true typhoid fever. It would also appear that gastric fever was commonly used as a synonym for typhoid fever.

Buckler (11) is authority for the statement that typhoid fever was very prevalent in grave form among the inmates, resident physicians, and students at the almshouse between 1846 and 1849 inclusive. During the last three of these years the wards were never free from cases. In 1847, Frank Donaldson demonstrated the intestinal lesions of typhoid fever in an immigrant dying at the Marine Hospital, and sent to the almshouse infirmary 2 cases of the disease removed from ships. The annual reports of the quarantine officer about this date and later mention not infrequently cases of this affection.

There were not lacking in Baltimore in 1840 able physicians, who were familiar with the natural history of typhoid fever. Among them were Professor Elisha Bartlett, who wrote his epochal book on *Continued fevers* here in 1842, Professor William Power, a pupil of Louis, and Thomas H. Buckler. The presence of this disease in Baltimore as early as 1812 is attested by the use of the term *nervous fever,* the old German name for typhoid fever, in the statistical nosology. It is not unlikely that the few cases of typhus mitior mentioned in the reports of the censors of the Medical and Chirurgical Faculty in 1809 and 1811 were typhoid fever.

When typhoid fever first made its appearance in Baltimore can not be ascertained. It is likely that it gained a foothold at an early date and became gradually more prevalent during the period of enormous growth of the city

between 1790 and 1830. From the increasing prevalence of the disease at the almshouse after 1845, and the first mention of cases in connection with shipping about this time, it is likely that it was imported on a large scale by the immigrants who poured in from Ireland and Germany between 1845 and 1860. It was doubtless very largely confused with malarial and typhus fevers, and between 1812 and 1850 was probably hidden in the statistical nosology under these headings as well as under nervous and gastric fevers and inflammation of the bowels. While up to 1850 the course of the disease can be traced but imperfectly as nervous and gastric fevers, after this date it can be followed with some degree of accuracy. Typhus fever probably, and malaria, inflammation of the bowels, diarrhœa, and gastric fever certainly, continued for some time to be credited with deaths due to typhoid fever. To make allowance for evident statistical errors of this nature, deaths from nervous, gastric, and typho-malarial fevers have been included in the list of typhoid-fever deaths. Deaths credited to typhus fever, negligible after 1860, diarrhœa, and inflammation of the bowels can not be so adjusted.

On the other hand, many deaths from other causes have been erroneously classified under typhoid fever. The more common of these are pneumonia, pleurisy, empyema, influenza, appendicitis, suppurative processes of the liver and of the biliary and urinary tracts, acute miliary tuberculosis, various cryptogenic suppurative infections, acute endocarditis, pyemia, and septicemia—the large group of affections often included under the term *typhoid state*. Conversely, deaths from typhoid fever have been credited to these. A decidedly unfavorable influence upon the Baltimore mortality rate from typhoid fever has been exerted by the deaths of non-residents, particularly from rural Maryland, brought to the city for treatment. During 1917 to 1919, inclusive, such persons were responsible for 20 per cent of the recorded deaths from this disease. Though the data upon which the mortality rates for typhoid fever are calculated are by no means exact, the rates probably approximate the truth closely enough to indicate the general trend of the curve of mortality during the period under consideration.

From table 19 it is seen that there were deaths recorded from nervous fever in each year but two from 1812 to 1824 and in every year from 1843 to 1845 and from 1848 to 1850 inclusive. Deaths were ascribed to gastric fever from 1837 to 1875 and 1878 to 1884 inclusive, and again in 1886. Typho-malarial fever, occurring first in 1876, was given as a cause of death from 1879 to 1898 inclusive. It is strange that gastric fever, which according to Geddings was a prevalent and fatal disease within the city in 1834, was not credited with deaths before 1837.

From the annual rates (table 19, graph 8) it is evident that typhoid fever as nervous fever was the cause of a not inconsiderable but fluctuating annual mortality between 1812 and 1824. Between 1825 and 1836 there is a complete absence of deaths ascribed to known synonyms of typhoid fever. The comparatively low annual rates from 1837 to 1842 are based on deaths recorded under gastric fever. Between 1843 and 1850 there was a considerable rise in the rates for gastric fever, and in all but two years a few deaths were credited to nervous fever. The highest rate so far attained was 27, in 1845. After 1850, with the appearance of typhoid fever in the nosology, the rates for gastric

fever underwent a sudden and permanent fall. The entrance of the term *typhoid fever* into the statistical nosology in 1851 was marked by an increase in the rate by 165 per cent over the previous year. Rising from 53 in 1851 and 1852 to 67 in 1853, the annual rates fell gradually to 42 in 1856. By 1860 the rates had risen to the level of 1851, and, continuing their ascent, they reached 80 in 1861 and 94 in 1862. Remaining high, but with considerable fluctuations from year to year, the annual rates attained their highest point, 106, in 1870. After this date the annual rates declined slowly and hesitatingly, sometimes with but slight variation, for a period of several years, and now and again with sharp rises and declines. By 1886 the rates had fallen to the level of 1851. After remaining at about 52 for 4 years, there was another period of fluctuation lasting until 1895. After stabilizing around 40 for 4 years, the rates descended again, and by 1901 had reached 27. From this point there was a sharp reaction covering the next 8 years, during which the rates reached 42 in two years. In 1909 the rate dropped to 24. In 1910 there was a reaction to 41, succeeded by a fall to 26 in 1911. During the succeeding 4 years the rates were almost stationary at an average rate of 22. From 1916 the rates fell continuously, and at a more rapid rate each succeeding year, to 5 in 1920.

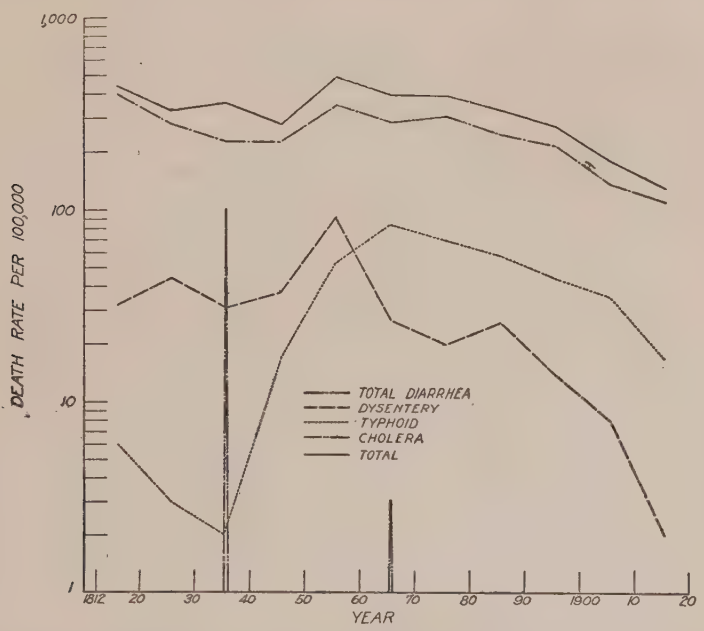
In studying the curve of the rates averaged for 5-year periods (table 20, graph 9), the periods before 1835 may be disregarded. Beginning with a rate of 4 for the quinquennium ending in 1840, the rates rose rapidly during the next 15 years and had attained 58 by 1851–1855. After a drop to 48 for the period ending in 1860 there was a jump to 82 in 1861–1865, and 87 was reached in 1870. From this high peak the rates declined sharply during the next 10 years to 61. After remaining practically stationary between 1876–1880 and 1881–1885, there was a somewhat uneven decline to 12 in 1916–1920.

For the rates as averaged for 10-year periods (table 20, graph 10), the curve is so smoothed that the rise in the rates from 1841–1850 to a peak in 1861–1870 and the fall afterwards are both continuous. The angle of the ascent is, however, much more acute than that of the descent. The rate of the fall for the 30 years, 1870 to 1900, was fairly even. It slowed up materially for the next 10 years, but between 1910 and 1920 it was considerable.

On comparing the curves for typhoid fever and for dysentery and diarrhœa, on the basis of the annual rates averaged for 5-year periods, it is observed that between 1815 and 1830 the three rose and fell together, and the correspondence in the shape of the curves for typhoid and dysentery is remarkably close. Between 1840 and 1855 the three again rose together, and all reached a peak in the latter year. They fell together between 1855 and 1860. While typhoid and diarrhœa reacted to another peak attained in 1866–1870 and fell together during the succeeding 10 years, dysentery fell decidedly between 1860 and 1865, reacted only slightly in 1866–1870, and then fell continuously and sharply until 1886–1890. On the other hand, when diarrhœa began in 1890 a sharp rise which culminated in 1891–1895, and dysentery rose to a peak in 1886–1890, typhoid fever pursued its gradual decline uninterruptedly. The considerable fall in the rates for diarrhœa and dysentery which occurred between 1900 and 1910 were not associated with a correspondingly acute fall in the rate for typhoid fever. In a general way, therefore, the courses of the curves for these three acute intestinal diseases of different etiology but with the same modes

of spread are rather closely alike during some parts of the period under consideration; at others they deviate widely.

Data are available from 1889 to 1919, inclusive, for calculating mortality rates according to color and sex. These are set forth in table 26. The rates for the white population follow closely those for the whole population, but those for the former exceed those for the latter slightly in 1893, and the rates for the two are equal in 7 years—in 1892, 1896, 1897, 1908, 1912, 1916, and 1919. The white rates are lower than the negro rates, except in 1893 and 1896, and the rates for the two races are equal in 1892, 1908, and 1916. The rates for white females exceed those for the males and for the whole population in 1892



GRAPH 10 (from table 20). Crude mortality rates from diarrhœa, dysentery, asiatic cholera and typhoid fever, averaged by 10-year periods, from 1812 to 1920, inclusive.

and 1893, are decidedly lower than the other two after 1894, and in general follow closely the rise and fall of the other rates, particularly those for total white and the total population. The rates for white males, except in 1892 and 1893, are uniformly higher than those for white females and for the total white population.

The annual fluctuations in the rates for colored are much greater than in those for the white population, and therefore the courses of their curves are much less smooth. The curve for the total negro rate falls considerably below those for the whole population and for the whites in 1893, but otherwise it is considerably higher. The rates for negro females are much lower than those for negro males, except in 1891, 1893, 1901, and 1913, when the converse is true.

It is clear that the mortality rates for typhoid fever have been markedly influenced by race and sex. Since the rates for the negro population are much higher than those for the white, and the rates for females of both races are lower than those for males, the total rate is influenced favorably by a low proportion of negroes and high proportion of females in the population.

The age distribution of the deaths from typhoid in 1910 is given in table 27.

TABLE 26.—*Number of deaths and rate of death, per 100,000 living inhabitants, from typhoid fever, according to color and sex, from 1889 to 1920, inclusive.*

D = death. R = rate.

Year.	Total.						White.						Colored.					
	Total.		Male.		Fem.		Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1889	224	52	111	55	113	50	181	50	88	51	93	49	43	66	23	81	20	55
1890	301	69	161	78	140	61	244	66	135	76	109	57	57	86	26	90	31	84
1891	189	43	95	45	94	40	157	42	82	46	75	38	32	48	13	44	19	51
1892	226	50	100	47	117	49	192	50	90	49	102	51	34	50	19	63	15	39
1893	255	56	119	55	136	57	228	59	108	58	120	60	27	39	11	36	16	41
1894	257	55	126	57	131	54	207	53	103	54	104	51	50	71	23	74	27	69
1895	192	41	103	46	89	36	157	39	82	43	75	36	35	49	21	66	14	35
1896	204	43	109	48	95	38	174	43	93	48	81	39	30	41	16	49	14	34
1897	209	43	119	51	90	35	175	43	99	50	76	36	34	46	20	61	14	34
1898	201	41	115	49	86	33	158	38	96	48	62	29	43	57	19	57	24	57
1899	153	31	85	36	68	26	119	28	67	33	52	24	34	44	18	53	16	38
1900	189	37	104	43	85	32	152	35	83	40	69	31	37	48	21	61	16	37
1901	141	27	77	31	64	24	110	25	66	31	44	20	31	39	11	31	20	46
1902	220	42	123	50	97	36	172	39	99	46	73	32	48	60	24	67	24	54
1903	189	36	105	41	84	31	137	31	79	36	58	25	52	64	26	71	26	58
1904	199	37	117	46	82	30	158	35	91	41	67	29	41	50	26	70	15	33
1905	197	36	108	42	89	32	158	35	85	38	73	31	39	47	23	61	16	35
1906	183	33	108	41	75	26	141	31	83	37	58	24	42	49	25	65	17	36
1907	230	42	139	52	91	32	180	39	112	49	68	28	50	58	27	70	23	49
1908	180	32	103	38	77	27	152	32	84	36	68	28	28	32	19	48	9	19
1909	136	24	85	31	51	17	107	22	67	29	40	16	29	33	18	45	11	23
1910	235	41	124	45	111	38	192	40	101	43	91	37	43	48	23	57	20	41
1911	154	27	94	34	60	20	124	25	79	33	45	18	30	33	15	36	15	30
1912	136	23	72	25	64	21	111	23	60	25	51	20	25	27	12	29	13	26
1913	135	23	68	24	67	22	92	19	51	21	41	16	43	46	17	40	26	51
1914	130	22	70	24	60	20	107	21	57	23	50	20	23	24	13	30	10	19
1915	128	21	74	25	54	18	89	18	55	22	34	13	39	41	19	44	20	38
1916	107	18	62	21	45	14	90	18	51	20	39	15	17	18	11	25	6	11
1917	92	15	53	18	39	12	72	14	41	16	31	12	20	20	12	27	8	15
1918	73	12	48	16	25	8	50	10	36	14	14	5	23	23	12	26	11	20
1919	60	8	36	10	24	7	50	8	28	9	22	7	10	10	8	17	2	4
1920	35	5	19	5	16	4	23	4	13	4	10	3	12	11	6	11	6	11

Considering first the total population, it will be noted that beginning with the second year of life with a rate of 10, from the second to the fifth year the mortality is doubled, from the fifth to the tenth year the rate was 26, and from the tenth to the twentieth year 40. The highest mortality fell in the third decade of life with a rate of 56. During the fourth, fifth, and sixth decades, the rates fell by rather even steps, and the sixth decade of life was marked by a mortality rate of 13. During the seventh decade the rate was more than double that of the sixth, but for the eighth decade it dropped to 19. The rates for

total whites varied little from those for the total population, except that they were lower between the fifth and ninth years. The rates for the negroes were uniformly higher than those for whites in nearly all age-groups. In regard to the whites, the rates for females were higher than those for males below the tenth year and between the tenth and nineteenth years. In the fourth decade, the male rate was more than three times as high as that for females, and in the fifth decade it was double the female. In the sixth decade the female rate was higher. Above the fifty-ninth year the mortality was considerably higher in males than in females. Among negroes, under the tenth year the rates were higher for females, but between the tenth and twenty-ninth years this was reversed. In the fourth, fifth, and seventh decades the rate for females

TABLE 27.—*Number of deaths and rate of death, per 100,000 living inhabitants, from typhoid fever, according to age, color, and sex, for 1910.*

D = death. R = rate.

Age period.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
Under 1 year.....	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Between 1 and 2 years	1	10	1	12	1	23	...	...	...	...	...	...	...	...
2 to 4 years.....	6	19	5	18	1	7	4	29	1	24	...	...	1	47
5 to 9 years.....	13	26	8	19	4	18	4	19	5	78	2	65	3	89
Under 10 years.....	20	20	14	16	6	13	8	18	6	46	2	32	4	59
10 to 19 years.....	41	40	33	37	14	33	19	41	8	58	5	85	3	38
20 to 29 years.....	63	56	51	55	26	58	25	52	12	58	8	88	4	35
30 to 39 years.....	40	45	32	44	24	67	8	21	8	51	3	39	5	61
40 to 49 years.....	21	31	18	31	12	44	6	20	3	26	1	18	2	35
50 to 59 years.....	6	13	5	13	2	11	3	15	1	16	1	34	...	...
60 to 68 years.....	8	32	7	32	5	51	2	17	1	35	...	...	1	64
70 to 79 years.....	2	19	2	21	1	25	1	18	...	...	...	...	...	...
80 years and over....	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	201	36	162	34	90	39	72	29	39	46	20	51	19	42

was much higher than for males, but in the sixth decade the males had the advantage of a lower rate.

It was not until after the beginning of the decline of typhoid fever in Baltimore that in the annual reports of the health department a gleam of interest in the disease on the part of the authorities can be discovered. In 1875, Commissioner Stuart attributed its prevalence to sewer-gas entering houses from imperfectly trapped cesspools. By 1885, though still clinging to this theory and basing his administrative acts chiefly upon it, he started routine chemical examinations of the waters of the wells and springs, and in a few years had condemned many of these. He also about this time began to question the safety of the general water-supply. By 1890 it was well recognized that the disease was more prevalent in the newly annexed territory, with its water-supply derived almost entirely from wells, that many of the cases in the rest of the city contracted the disease without the city, and that large numbers of

non-residents suffering with the disease were brought into the city for treatment. Commissioner McShane established sanitary inspection of the Lake Roland water-supply in 1892, and 4 years later extended it to the Gunpowder watershed. Basing his opinion upon reports of his inspectors, he declared in 1896 that the general water-supply was seriously polluted from privies on these sheds. In 1895 a small outbreak was traced to a certain milk-supply. Case reporting, established by law in 1894, had reached some degree of completeness by 1900. The first study of typhoid fever was undertaken by Dr. C. Hampson Jones in 1899. During the next decade he pointed out that the disease was rather evenly distributed throughout the city, and that, though milk epidemics, infection from polluted wells, contact with previous cases in households, infection out of the city, and spread of the disease by flies all played a part, the great bulk of the cases were infected from the city water-supply. By 1910, thanks to the epidemiological inquiries of Dr. Jones and the investigations of Dr. Stokes, city bacteriologist, and of Dr. W. W. Ford (43), of the department of pathology and bacteriology of the Johns Hopkins University, it was generally recognized that the general water-supply was the chief means by which typhoid fever was spread in Baltimore.

With the aid of further and more exact data than had hitherto been available, the writer (59), inquired into the mode of infection of the cases reported from 1916 to 1919, inclusive. Not only had the general sanitary conditions materially changed since the date of Dr. Jones's studies, but in some ways they were constantly improving during the 4 years under consideration. The general results of the investigation, together with those of Assistant Commissioner of Health Dr. J. F. Hogan, in 1920, are given in table 28. The relatively high proportion of cases certainly, probably, and possibly infected without the city is striking. Most of those of the former division acquired the disease in rural Maryland, but a considerable proportion were infected in other States, notably Virginia, Pennsylvania, New Jersey, and New York. In some cases the disease was acquired as far away as Maine. In 1916, 14 cases were received from foreign ships. The percentage of infections attributed to recent cases in households and institutions in 1918 and 1919 are probably not far from the usual occurrence in average years, for it would appear from Dr. Jones's figures for 1904 to 1907, inclusive, based upon less accurate histories, from 7 to 9 per cent of the cases could be classed under this category. In the material for 1918, 1919, and 1920, many of these secondary cases occurred in hospitals among patients admitted for other affections, sometimes surgical, who were assigned beds next to those of typhoid patients and were attended by the same nurse. The secondary cases developing in homes were usually in the immediate attendants of the patient. It is probable that the 77 cases traced to milk (infected from actual cases or from proven carriers) in 1916–1917 were far short of actual occurrence. These cases all occurred in definite outbreaks.

The absence of recognized milk outbreaks in the last 3 years coincides with the improvement in the supervision of the milk-supply. The category ascribed to proven carriers in households is included among the group of certainly explained, because the evidence was so unusually strong in each instance as to amount to almost to a certainty. No cases were attributed to infection from springs, wells, and streams, except where there was definite information

that they were polluted from the discharges of typhoid patients. From one of the wells to which several cases were attributed, *B. typhosus* was isolated. Thirteen of the 15 cases ascribed to this mode of infection in 1920 occurred as a sudden outbreak among workers in a large office building in which a tank for flushing closets was supplied with water from a sewer pipe draining the overflow from the long-since abandoned Calvert Street city spring. By a cross-connection within the building the water from this tank mixed with that from the city water-supply. Analysis of water from both sources showed a high

TABLE 28.—*Modes and sources of infection of typhoid fever, from 1916 to 1920, inclusive.*

	1916		1917		1918		1919		1920	
	Cases.	Per cent. of cases.	Cases.	Per cent. of cases.	Cases.	Per cent. of cases.	Cases.	Per cent. of cases.	Cases.	Per cent. of cases.
Certainly explained.										
Outside of city	125	16	142	26	53	18	58	16	104	39
Contact with recent cases in same household or institution	?	?	21	4	39	13	42	12	16	4
Milk epidemics in which source of infection was demonstrated	34	4	43	8	...	...	...	...	...	...
Springs, wells, and streams within city	4	1	...	...	...	...	24	7	15	6
Proven carriers in households or institutions	14	2	2	...	5	2	2	1	1	...
Laboratory infections	...	...	...	...	1	...	2	1	...	...
Total	177	23	208	38	98	32	128	36	130	49
Probably explained.										
Outside of city	?	?	?	?	16	5	32	9	12	4
Remote cases in households, carrier not proven	?	?	13	2	22	7	27	8	6	2
Cases in neighborhood	?	?	?	?	?	?	7	2	3	1
Self-infection	...	...	4	1	4	1	...	...	...	...
Total	...	...	17	3	42	14	66	18	21	8
Possibly explained.										
Outside of city	?	?	?	?	20	7	15	4	...	...
Total explained	177	23	225	41	160	53	209	58	151	57
Total unexplained	597	77	319	59	142	47	149	42	116	43
Total cases	774	100	544	100	302	100	358	100	267	100

Leaders in columns denote absence of occurrence. Question marks in columns denote absence of information.

degree of pollution. The outbreak subsided after severance of connection between the two water-supplies. In the one instance of stream infection included, the stream was known to be polluted with sewage from houses harboring typhoid fever. Of 20 children who, while on a picnic, drank from this stream, 10 developed fever within 3 weeks. The 3 laboratory infections occurred among medical students who unintentionally sucked into their mouths through pipettes bouillon cultures of *B. typhosus*.

It will be noted that the proportion of cases in which the mode of infection was ascertained with certainty, during the 5 years, averaged 35.6 per cent.

Among the categories in which the mode of infection was ascertained with probability, two deserve some comment. Of the 8 cases included under self-infection, all the persons affected had had the disease before. As they were not in association with active cases, it is not improbable that they were chronic carriers who became infected from themselves. A more interesting group is formed by those who lived in households with individuals who had had typhoid fever from 1 to 30 years before. Of the 68 such persons (including 6 proven carriers), who in 1917 to 1919, inclusive, were suspected of transmitting typhoid fever to members of their households, 66 per cent were females, and this percentage of males to females was approximately the same in each year. The 45 females who were suspected or proven carriers bore relationships as follows to the typhoid-fever patients: Mother, 24; sisters, 12; wives, 3; grandmothers, 2; aunts, 1; domestic servants, 3. The 23 males in question held relationships to the patients as follows: Fathers, 9; brothers, 9; husbands, 3; uncles, 1; unrelated, 1. Not all of the suspected carriers were cultured and not all of the proven carriers can now be separated from the total. Since of the 5 of the latter that can be identified with certainty 4 were females (grandmother, sister, and aunt) and only 1 was a male (father), the proportion as above given would not be materially changed. As the proportion both of the proven and suspected carriers in this list who had relationships in the households most likely to be favorable for infecting food is strikingly high, and as for none of the cases, whom they were suspected of infecting, were any other likely sources of infection traceable, it is not improbable that the explanation is valid.

It was not until 1900 that case reporting was complete enough to yield morbidity rates worthy of serious consideration. It is possible that between 1900 and 1915 the errors arising from failure to report cases were largely offset by the practice of including, without careful investigation of the subsequent histories, all suspected cases from whom blood specimens submitted by attending physicians to the bacteriological laboratory gave positive agglutination reactions with *B. typhosus*. With the restricted personnel, it was not possible to follow each case in detail and to clear the records of cases reported on evidently mistaken diagnosis.

Before 1917, cases among non-residents from rural Maryland were included among the Baltimore cases; from this date they were not so included, but through the State Board of Health were officially transferred to the lists of the counties of origin. Some cases among residents, who, after contracting the disease in the counties, were brought to the city, also fell into this category. Cases in non-residents from other States, including the not inconsiderable number of cases removed from ships, and in residents who contracted the disease in other States, have always been included in the official lists of Baltimore cases. With fuller histories and more intensive oversight of cases than had hitherto been practicable, it was possible after 1915 to secure more accurate morbidity data. Therefore, for the 5-year period 1916–1920, it may be said that the number of reported cases of typhoid fever included in the official lists represents with a fair degree of certainty the actual occurrence of cases which under the regulations should be so listed. These figures do not, however, represent the true morbidity of local origin, for in these 5 years, on an average, 25 per cent of the cases were certainly infected without the city. Taking the

figures as they stand, the course of morbidity (table 29), though irregular, rose, on the whole, between 1900 and 1910. During this period the rates rose from 172 to 330, or nearly doubled. For the first 5 years (from 1900 to 1904) the curves of the morbidity and mortality rates rose and fell together. During the next 2 years the former rose and the latter fell. In 1907 the two rates rose together, but in 1908, while the morbidity rate remained stationary, the

TABLE 29.—*Morbidity rate, per 100,000 living inhabitants, and the percentage of case fatality for typhoid fever, from 1900 to 1919, inclusive.*

C = cases. R = rate.

Year.	Morbidity.		Deaths.	Per cent. case fatality.	Year.	Morbidity.		Deaths.	Per cent. case fatality.	Year.	Morbidity.		Deaths.	Per cent. case fatality.
	C	R				C	R				C	R		
1900..	871	172	189	22	1908..	1426	255	180	13	1916..	776	128	107	14
1901..	792	154	141	18	1909..	1069	189	136	13	1917..	544	89	92	17
1902..	1086	209	220	20	1910..	1891	330	235	12	1918..	302	49	73	24
1903..	768	146	189	25	1911..	1201	208	154	13	1919..	359	50	60	17
1904..	916	172	199	22	1912..	1083	185	136	13	1920..	267	36	35	13
1905..	1019	188	197	19	1913..	1163	197	135	12					
1906..	1215	222	183	15	1914..	757	127	130	17	Aver..	946	168	150	16
1907..	1417	256	230	16	1915..	949	158	128	13					

mortality rate fell. They rose simultaneously to a peak in 1910. In all except 3 of the 11 years the curves for morbidity and mortality rose and fell together. In the remaining 10 years of the period the morbidity rates fell from 330 to 36, a decrease of 89 per cent. The fall was not continuous, however, for in 1913, 1915, and 1919 there were reactions, that in 1915 being considerable.

TABLE 30.—*Rate of morbidity, per 100,000 living inhabitants, for typhoid fever by color and sex for 1918 and 1919.*

Year.	Total.	White.			Colored.		
		Total.	Male.	Fem.	Total.	Male.	Fem.
1918	46	47	61	34	39	29	48
1919	44	46	51	41	36	41	25
Average ...	45	46	56	37	37	35	36

The slight reaction in 1919 was associated with the annexation of that year, when the rate in the annexed territory was much higher than in the old city.

The rates for whites and negroes and for males and females, data for which are available only for 1918 and 1919, are given in table 30. If the figures for these two years may be taken as representative, the incidence of the disease is greater in the white race than in the colored, greatest in white males, and greater in white females than in either colored males or females.

As the value of case-fatality rates is so intimately dependent upon the accuracy of morbidity and mortality figures, it is necessary in considering them to bear in mind the explanations already given of these. Particularly important is it to recall that while deaths of all non-residents have been continuously recorded in the city tables of mortality since 1916, the cases among non-residents of rural Maryland brought to Baltimore have been excluded from the morbidity lists. Therefore, for the five years between 1916 and 1920, the case-fatality rates are not directly comparable with those of previous years. In table 29 the case-fatality rates in percentages are given from 1900 to 1920. In this period they fluctuate rather widely, between 25 per cent, the highest, and 12 per cent, the lowest. In 11 of the 21 years they were over 15 per cent; the lowest rate, 12 per cent, was recorded in two years, rates of 13 per cent, in six years, and of 14 and 15 per cent in 1 year. With the exception of 1918, when in October a number of individuals with typhoid fever died with influenza, rates of 18 per cent or over occurred only during the first 6 years of this

TABLE 31.—*Case-fatality rates for typhoid fever, according to color and sex, for the old 24 wards of Baltimore, for 1919.*

	Mortality.	Morbidity.	Percentage case fatality.
Total males	27	159	17
Total females	17	134	13
Total white	35	259	14
White males	20	139	14
White females	15	120	13
Total colored	9	34	26
Colored males	7	20	35
Colored females	2	14	14
Total	44	293	15

period. It will be noted that the 6 years, 1908 through 1913, stand out as an unbroken period of exceptionally low rates. A rise in the rates to 17 per cent in 1914 was followed by a fall to 13 per cent and 14 per cent in 1915 and 1916, respectively. High rates in the next 2 years were succeeded by a return to 13 per cent in 1920. However, when the rates from 1917 to 1920 are adjusted to the basis of previous years by the addition to the divisors (i. e., the reported cases) of those cases from rural Maryland which were transferred to their places of origin, or, what amounts to the same thing, by the subtraction from the dividends of the deaths occurring among them, the rates are 13 per cent, 18 per cent, 15 per cent, and 13 per cent instead of the higher official figures given in the table. It would appear, therefore, that if case reporting be considered as fairly accurate since 1906, the normal range of case fatality in Baltimore varies from 12 per cent to 18 per cent, with an average of 14 per cent.

Accurate data for determining the influence of sex and color upon the fatality rates of typhoid fever are limited to 1919. These are analyzed in table 31. Owing to the smallness of the figures for some categories and the lack of correction for age, some of the percentages are perhaps subject to con-

siderable probable error. Taken at their face value, the risk rate of dying of clinically recognized typhoid fever was twice as great for colored as for white, somewhat greater for white males than for white females, over twice as great for colored males than for colored females, and a fourth greater for total males than for total females.

Whereas it would appear that the greatest incidence of typhoid fever in Baltimore has been in the summer and autumn, in many years between 1856 and 1881 the number of deaths in the winter months, December, January, and February, equaled or even exceeded that for the warm months. Since 1881 the bulk of the deaths have fallen in the summer and autumn. Since case reporting was instituted the cases have shown the same seasonal distribution. The four years 1915–1919 (table 32) may fairly illustrate the average seasonal distribution of deaths. The deaths lag about one month behind the reported

TABLE 32.—*Number of deaths by months and monthly annual mortality rate, per 100,000 living inhabitants, from typhoid fever, from 1915 to 1919, inclusive.*

D = death. R = rate.

	1915		1916		1917		1918		1919	
	D	R	D	R	D	R	D	R	D	R
Jan.	11	22	8	16	7	13	2	4	4	7
Feb.	7	15	4	9	3	6	3	6	5	9
Mar. ...	5	10	2	4	4	8	2	4	4	7
Apr.	6	12	4	8	8	16	7	14	...	...
May	4	8	3	6	7	13	3	6	8	13
June ...	9	18	7	14	3	6	2	4	4	7
July	14	27	14	27	6	12	5	10	3	5
Aug. ...	14	27	11	21	13	25	14	27	8	13
Sept. ...	22	45	20	40	13	26	11	22	9	15
Oct.	12	23	21	41	14	27	17	32	5	8
Nov.	17	34	10	20	9	18	1	2	6	10
Dec.	7	14	3	6	5	10	6	11	4	7
Total .	128	21	107	18	92	15	73	12	60	8

cases, but follow the same general course. For cases, with February usually as the month of lowest incidence, there is a gradual progression of the disease until July, when there is a rapid rise culminating in a peak usually about the middle of September, or more rarely the last of August or even early in October. The decline is usually very abrupt during the first month after the peak, and then more gradual to the end of the cycle.

Administrative measures directed particularly to the control of typhoid fever developed very gradually. As early as 1888, wells to which certain cases were traced were closed, and a few years later from time to time several local epidemics traced to milk were controlled by shutting off the contaminated milk-supplies. It was not until 1912, however, that measures were taken routinely to prevent the entrance into the city of milk from farms harboring cases of typhoid fever and to guard milk within the city from infection from cases on the premises of milk handlers and of the general public. Investigations conducted in 1916 and 1917 showed that in spite of these barriers

numbers of small milk epidemics occurred. Only since 1916 have cultures been made of suspected carriers on dairy farms, among milk and other food handlers, and in households and institutions, and control exercised over proven carriers. It was not until 1916 that printed instructions giving in detail the precautionary measures to be taken to prevent the spread of typhoid fever were delivered to households and institutions with patients with this disease, and attempts made to enforce them through the health wardens and nurses. Since this date special efforts have been made to have patients from crowded households removed to hospitals. Since its introduction the health department has systematically urged the use of protective inoculation, and has required it of attendants in hospitals receiving typhoid fever patients. The response on the part of the general public has not been encouraging, and the decrease in the incidence of the disease of late years can not be credited in any large degree to this method of protection. Whereas no exact quantitative valuation can be set upon them, there is a large body of evidence supporting the inference that restrictive measures imposed on the acts of persons by the health department and by physicians have very materially decreased the spread of typhoid fever in the community during the last decade.

SUMMARY.

When the curve for the annual rates for the acute intestinal diseases as a whole is viewed for the entire period, several distinct waves of mortality stand out clearly. (Table 19, graph 8.) The first, beginning at some unknown time previous to 1812 and characterized by rates fluctuating between 297 in 1814 and 664 in 1818, ended in 1827 with the comparatively low rate of 181. The second wave, starting in 1828, reached its peak in 1832 with the remarkably high rate of 1,412 and receded very brokenly to its low point in 1839 with a rate of 162. But for the influence of the cholera epidemics of 1832 and 1834, the rates in these years would have stood at 486 and 340 instead of 1,412 and 412, respectively. However, as it is certain that a considerable number of deaths from cholera were attributed to cholera infantum and to cholera morbus and cramp colic, it is evident that cholera exercised an influence upon the high rates for these two years even greater than is shown by the official figures. It is equally clear, however, that before the advent of cholera the rates were tending to higher levels during the first few years of this period. The third wave, not only short but relatively low, reached its peak in 1842 with a rate of 252. By 1845 it had subsided to 167. The fourth wave, characterized by excessively high rates, began in 1846 and ended in 1865. The rise in the rates to a peak of 659 in 1854 was gradual, but somewhat irregular. The fall to the end of the wave, with a rate of 342 was almost uninterrupted. This wave was associated with a rise in the rates for every one of the separate causes, including cholera. The latter disease, though hidden under other rubrics, contributed in no small degree to the high rates of 1849 and 1854 and perhaps other years. Coincident with the return of cholera in 1866, a fifth wave began, reached a peak in 1874 with a rate of 528, and subsided in 1878, when the rate stood at 264. A sixth wave, beginning in 1879 and running an irregular course, attained its peak in 1890 with a rate of 390 and subsided in 1903, when the rate fell to 162. After an interval of 64 years, the rate now stood at the same level as

in 1839. The seventh and last wave, which began in 1904, is still in progress. It is characterized by relatively low and, on the whole, constantly descending rates, which during the last 5 years have shown a tendency to stabilize around a comparatively low level. During the whole period, with the exception of a few years, the slope of the curve has been determined chiefly by cholera infantum, which, but for cholera and for diarrhœa in occasional years, has been the chief contributor.

The course of mortality for the group as a whole in relation to that for its various members may be studied conveniently in the curves for the rates as averaged for 5-year periods. (Table 20, graph 9.) For more accurate comparison, the rates for cholera infantum and diarrhœa are given in combination as well as separately. It will be observed that beginning with a rate of 406 for the 4 years ending in 1815, the whole rate stood at 462 in 1816–1820, 413 in 1821–1825, and 242 in 1826–1830. The averaged rates for each of the separate rubrics, cholera infantum, diarrhœa (and for these two combined), and typhoid fever, all rose and fell with the total rate. For the 5-year period ending in 1835, this favorable course was reversed and the total rate rose to 517. This change was associated with a stationary state for the rate for diarrhœa and a fall in that for typhoid fever and a relatively slight rise in that for dysentery. The rate for cholera infantum rose sharply. The determining cause for this notable rise in the total rate was the entry of a new element, Asiatic cholera, in 1832 and 1834. But for these events the elevation of the total rate for this 5-year period would have been relatively slight, i. e., only 75, when the averaged rates of 200 due to cholera are subtracted from the total rates. Concurrent with the declines in rates for each separate rubric, except the negligible typhoid rate, there was a sharp fall to 202 in the total rate for the 5 years ending in 1840. In 1845 the combined rate stood practically unchanged at 208. Since 1825, therefore, it had declined by approximately 50 per cent. This striking change was due to declines in the rates for cholera infantum, diarrhœa, and dysentery, and of the absence of cholera between 1835 and 1840. In other words, this result was brought about by declines during the 20-year period, 1826–1845, in the rates for the indigenous members of the group. The total rate was not destined again to attain so low a level until 1905.

That this fall in the rates was not due to failure to register deaths is proven by the fact that Joynes, Wynne, and Frick, who made careful statistical studies of the Baltimore material of this time, accepted the official figures of the total number of deaths as substantially correct and by the evidence that the decline in the rates for this particular group of diseases coincided with a similar decline in the death-rates for all causes. In the 5-year period ending in 1850, the whole situation changed. Due to corresponding changes in the rates for cholera infantum, diarrhœa, dysentery, and typhoid fever, the total rate rose to 357. By 1855 it had surpassed any previous high level and stood at 534. This time, in addition to rises for the three usually responsible rubrics, typhoid fever, hitherto unimportant, achieved a rate of 58, and cholera, present in 1854 in a form much more fatal than was officially recognized, added materially to the toll of death from these diseases. For the 5 years ending in 1860, as the result of the absence of cholera and decline in the rates for diarrhœa, dysentery, and typhoid fever, the total rate fell to 475. Cholera infantum rose, however, to 300, the highest level yet recorded. A further decline in

the total rate to 373 in 1861–1865 was owing mainly to a sharp drop in the rates for cholera infantum and for dysentery; typhoid fever rose conspicuously. This improvement in the total rate was but temporary, for, turning upward, it registered 436 in 1866–1870. This change, while influenced to some degree by a small outbreak of cholera in 1866, was brought about chiefly by increases in the rates for cholera infantum, diarrhœa, dysentery, and typhoid fever. The rate for the latter had now reached the highest point recorded in its history. With slight declines in other rubrics and a sharp rise in cholera infantum, the total rate stood at 457 in 1871–1875. With recessions for every rubric, the total rates declined to 346 in 1876–1880 and 316 in 1881–1885.

During the 40 years between 1846 and 1885 there was, then, a very conspicuous change in the curve for the acute intestinal diseases, resulting in a wave with two sharp crests, the first in 1860 and the second in 1875. This change was brought about during the first crest in part by two relatively moderate visitations of cholera (1849 and 1854), but mainly by unusual fatality from dysentery, cholera infantum, diarrhœa, and typhoid fever, and during the second crest by high rates for all the other members of the group save dysentery and cholera. The decline in the total rate between these two crests, which reached its lowest point during the Civil War, was due to a fall in the rates for cholera infantum and dysentery and to the absence of cholera. Cholera played no conspicuous rôle after 1866. The influence of the decline in the rates for cholera infantum, dysentery, and typhoid fever upon the total rate after 1875 is very evident. The ascent in the total rate to 359 during the 5-year period ending in 1886–1890 was due to sharp rises in the rates for dysentery and diarrhœa. Cholera infantum remained stationary, and typhoid fever continued its gradual decline. During the 25 years between 1891 and 1915 the total rate fell uninterruptedly from 359 to 131, but the rate of decline was much less acute during the first three than during the last two quinquennia of the period. After 1900, dysentery ceased to be a factor of importance and typhoid fever continued to fall. But for an upward turn between 1901 and 1905, the decline in the rate for cholera infantum was continuous. Diarrhœa, after rising slightly between 1891 and 1895, had fallen to a relatively low level by 1905. The rates for these two rubrics taken together fell continuously between 1891 and 1915. There was no fall in the total rate for the 5 years ending in 1920. The considerable fall for typhoid fever was counterbalanced by slight reactions in the rates for the other rubrics.

To what degree may the courses of these diseases be explained by changes in environment and population and by improvements in medical care and administrative efforts of a special character on the part of the health department? In the history of the water-supply it has been pointed out that the drinking-water has been subject to pollution from the earliest times. The intra-urban supply from springs and wells, the main dependence of the major part of the population until after 1850, must have been seriously polluted from the earliest days. Contamination was doubtless to some degree lessened for a time at least after the enforcement of the ordinances of 1817 and 1820 requiring the abandonment of privies in certain localities and the water-tight construction of cesspools near springs and wells. That these measures were not thoroughly protective seems certain, for the evidence at hand indicates that cholera was commonly if not invariably spread by the internal water-supply, and that the cesspools were

constantly overflowing. With the rapid increase in the population, particularly between 1800 and 1830 and between 1846 and 1855, the pollution of the springs and wells must have grown rapidly worse. Many were closed by administrative authority between 1870 and 1900, and after the latter date but few remained.

The external water-supply, available to only a small proportion of the population when introduced in 1808, served perhaps one-third of the people by 1825 and at most one-half by 1850. It is improbable that it was seriously polluted before 1845 or 1850. From this date until 1881, when the Gunpowder supply became the chief source, the pollution must have been very grave. This latter supply, which became progressively the subject of contamination from the increase in the village and farming population on its tributaries, was improved to a considerable degree by storage in the numerous reservoirs in the city. Until 1915 water from the heavily polluted Jones Falls–Lake Roland watershed was mixed with it. By 1895 both water-sheds were so contaminated that sanitary inspectors were employed to guard them. There is abundant evidence that between 1845 and 1911, when chlorinization was introduced, either part or all of the external water-supply was subject to serious pollution with excreta of man and domestic animals. Chlorinization since 1911 and filtration and chlorinization, together with the abandonment of the Lake Roland supply since 1915 and the partial abatement of nuisances on the Gunpowder watershed, have greatly reduced but not entirely offset the dangers of pollution of the drinking-water. It is probable that since 1919, at least, it has been at most times free from micro-organisms responsible for the acute intestinal affections. Highly important in connection with the pollution of the external water-supply is the circumstance that it has never been subject to contamination from the intestinal discharges of large communities of human beings. The complete absence of large towns and of cities on the water-sheds has doubtless meant much in this regard. With the exception of Towson, a town of 1,000 inhabitants on the Lake Roland watershed, the pollution of the external water-supply with human excreta has been limited to that derived from a relatively thinly settled countryside dotted with occasional villages. While the pollution from these sources has been far from negligible and has increased markedly in recent years, it has never been comparable in degree with that obtaining in connection with the watersheds of many American and foreign cities. Had there been large urban communities discharging sewage into the sources of the Jones Falls and in later years into those of the Lake Roland and Gunpowder watersheds, Baltimore could hardly have escaped so lightly from cholera, and the rates from typhoid fever, dysentery, and diarrhœa must have been notably higher than those experienced. From the consideration of nuisances connected with imperfect drainage, privies, cesspools, lack of proper paving, and defective methods of removal and disposal of garbage and manure, it is evident that, until very recent years, conditions were most favorable for the spread of this group of diseases by pollution of the intraurban water-supply and of milk and by flies and other insects. With the gradual abandonment of wells and springs within the city between 1870 and 1900, the danger from privies and cesspools was practically limited to the possibilities of spread of infection by flies, and great as were the esthetic benefits of the new sewage system, its actual sanitary influence when brought into service between 1912 and 1918 was much less marked than would have been the case at an earlier date. As a result of the

marked general improvement in municipal housekeeping during the last 20 years, and particularly since 1910, the danger from fly infection has greatly decreased.

In the discussions of the milk-supply it has been made clear that, before administrative efforts at its control were begun in 1894, a large proportion of the milk was deficient in quality and exposed constantly to numerous opportunities for contamination. Until the ice-supply was increased and cheapened through improvements in transportation and storage, and artificial ice became available, much of the milk was either not refrigerated at all or, at least, very defectively. The administrative reforms begun in 1894 showed results almost immediately in the great improved food value of milk and in the cutting down to some degree of the possibilities of contamination from impure water and from flies. In spite of laws and of persistent and well-directed administrative efforts, as late as 1917 the general sanitary conditions under which the bulk of the milk was handled were deplorable and the opportunities for contamination were endless. Until this date milk-borne outbreaks of typhoid fever were common, and with the notable exception of the Walker-Gordon Laboratory and of a few dealers who in recent years pasteurized with care, the milk-supply was doubtless often infected with the causal agents of dysentery and diarrhœa as well. Whatever dangers may be incident to high bacterial content were almost constant attributes of the bulk of the milk until the fall of 1918.

Of other foods likely to be infected outside the city, the fresh vegetables commonly eaten raw, such as lettuce, celery, radishes, cabbage for slaw, and the like, and fruits like strawberries, were perhaps not infrequently contaminated from city night-soil so generally used as fertilizer by neighboring farmers. Danger from this source persisted until 1917.

While the great oyster-beds of the lower Chesapeake have always been reasonably safe from sewage contamination, opportunity for the spread of typhoid fever and perhaps of dysentery and diarrhœa by infected oysters has existed from the earliest times until recent years. In earlier years productive oyster-beds were near enough to the city to be contaminated from the sewage-polluted waters of the city streams and the basin, but a more serious menace in this regard was due to the custom, proscribed only in the last few years, of fattening oysters in polluted waters off the towns below the city.

The imperfect methods of collection and disposal of garbage, slaughter and packing house refuse, night-soil, and stable manure which obtained until the last few years resulted in the presence in houses, cellars, yards, courts, alleys, streets, streams, and the basin of an abundance of organic matter to attract and to feed the swarms of flies bred in the numerous stables within the city.

When the growth-rates of the population expressed in percentages of increase and the averaged death-rates from this group of diseases are compared (table 33) over decennial periods, a very definite correlation is evident. The very high death-rate for the decennium ending in 1820 followed growth increases of 76 per cent between 1801 and 1810 and of 35 per cent between 1811 and 1820. A decided decline in the death-rate by 1830 coincided with a continued fall in the rate of population increase. The practically stationary state of the rate of population increase between 1831 and 1840 was accompanied by a relatively slight increase in the death-rate in 1840 and a fall in 1850 to the lowest level recorded until 1900. But for the occurrence of epidemic cholera in 1832 and

1834, the death-rate for the period ending in 1840 would have shown a decided drop. It is clear, then, that, so far as the indigenous diseases of this group are concerned, in a period of diminishing immigration following a period of very high immigration-rates, the death-rates fell significantly from a very high to a relatively low level. But between 1841 and 1850 the rate of population increase jumped to 65 per cent and was reflected in 1860 by an increase in the death-rate by 80 per cent over 1850. With the decline in the percentages of population increase to 26 for the decennia ending in 1860 and in 1870 and 24 for that ending in 1880, the death-rates fell by 20 per cent in 1870, remained stationary in the next decade, and declined considerably between 1881 and 1890 in the face of a slight increase in the rate of population growth during this last period. From 1891 to 1910 the rates for mortality and for population growth fell steadily together. With a slight rise in the rate of population growth between 1911 and 1920, the fall in the death-rate was less acute than in the previous decennium. The close correspondence between these fluctuations

TABLE 33.—*Percentage of population increase between census counts contrasted with average rates of deaths, per 100,000 living inhabitants, by 10-year periods from acute intestinal diseases, from 1800 to 1920, inclusive.*

Periods.	Per cent. of population increase between census counts.	Average rates of death from acute intestinal diseases by 10-year periods.	Periods.	Per cent. of population increase between census counts.	Average rates of death from acute intestinal diseases by 10-year periods.
1801-1810....	76	...	1861-1870....	26	404*
1811-1820....	35	437	1871-1880....	24	402
1821-1830....	29	328	1881-1890....	31	338
1831-1840....	27	360*	1891-1900....	17	278
1841-1850....	65	280	1901-1910....	10	182
1851-1860....	26	505*	1911-1920....	14	131

* Periods during which there occurred epidemics of cholera.

in rates of population growth and the death-rates from this group of diseases finds a ready explanation in the recorded history of the general sanitation of the city. The periods of rapid growth were marked by overcrowding and by a multiplication of nuisances of all types, but especially of those connected with the pollution first of the internal and then of the external water-supply. A considerable period elapsed before the ill effects of the great migration 1846 to 1855 could be even partially adjusted by construction and administration, and the sanitary habits of the newcomers, many of whom had been accustomed to live in cellars or hovels, had approached the level of those of the older citizenship. Any considerable degree of slackening of immigration would, on the other hand, exercise a salutary effect.

As foreign immigrants have higher birth-rates than the native-born, and as high birth-rates result in a larger proportion in the population of those most susceptible to acute intestinal affections, it is to be supposed that high immigration-rates, such as occurred between 1846 and 1855, would be followed by a period of high death-rates from these diseases, and notably from cholera infantum. As according to the figures of Frick in 1850, the mortality-rates for cholera infantum were more than double and those for dysentery were more

than four times greater in whites than in negroes, and, as in 1919, typhoid fever was more than twice as fatal for negroes as for whites, it may be concluded that a large proportion of negroes has exerted a favorable effect upon the death-rates for the former and an unfavorbale effect upon those for the latter. There can be little doubt that the fall in the rates since 1880 have been due to some degree to the habit of a large proportion of the foreign immigrant women entering after that date to nurse their babies. It is certain that typhoid fever and dysentery were introduced on a large scale by foreign immigrants in the middle of the last century. Indeed, the epidemic outbreak of dysentery at that time is probably to be laid at their door. There is reason to suppose that these diseases spread to the civil population from the large number of cases brought to the large military hospitals established in the city during the Civil War. It has been established that not only have many cases of typhoid fever been brought into the city for treatment from rural Maryland and by foreign and coastwise shipping, but that many citizens have acquired both typhoid fever and dysentery while on visits elsewhere. It has been shown that the health department has never undertaken the sanitary control of persons with dysentery, diarrhœa, and cholera infantum, and that measures of this nature were first applied to cholera in 1866 and to typhoid fever in 1916. While a favorable outcome in dysentery and diarrhœa have undoubtedly been determined by medical treatment since the earliest days, it is doubtful if medical care influenced the death-rate from cholera, or, if before 1885 or 1890, the fate of individuals with cholera infantum or typhoid fever was on the whole very materially affected by the ministrations of the average physician or hospital. Beyond question, since 1890 most of the decline in the death-rate from cholera infantum and much of that from typhoid fever, and to a considerable degree the decrease in the incidence of both, are to be ascribed to the actions of medical men.

Chapter XI.—Typically Contactive Diseases.

1. Acute exanthematous diseases: Small-pox; Cowpox; Chicken-pox; Scarlet fever; Measles; Influenza. (Tables 34 to 59, graphs 11 to 16.)
2. Acute inflammatory affections of the respiratory tract: Whooping-cough; Diphtheria; Pneumonia. (Tables 60 to 77, graphs 17 to 20.)
3. Tuberculosis. (Tables 78 to 90, graphs 21 to 26.)

THE EXANTHEMATOUS DISEASES, OR THOSE ACUTE FEBRILE COMMUNICABLE DISEASES CHARACTERIZED BY ERUPTIONS OF THE SKIN AND CERTAIN MUCOUS MEMBRANES.

The diseases of this class which have been recognized in the statistical nosology of the Baltimore health department are variola or small-pox, vaccinia or cow-pox, varicella or chicken-pox, morbilli or measles, scarlatina or scarlet fever, and influenza. The members of this group of diseases have in common many characteristics. These concern especially the seats and characters of their principal lesions, their mode of spread, their seasonal distribution, their reaction upon the community, their age incidence, and to a certain degree their causation and their immunity relations. They are all marked by cutaneous eruptions symmetrically distributed, and which for three (small-pox, chicken-pox, and vaccinia, especially when generalized) are so alike in appearance and anatomical changes that in many respects they can be differentiated only after close study. The early eruption of small-pox, and especially in the severe cases in which death occurs early in the disease, closely resembles those of measles and scarlet fever, and the latter two were until comparatively recent times confused with each other and with small-pox.

The cutaneous eruptions of measles, scarlet fever, and influenza, though widely different from the more marked inflammatory lesions of small-pox and chicken-pox, are among themselves of the same general character, and, except for certain peculiarities of surface distribution and arrangement, often so alike as to give rise to confusion in diagnosis.

In all of them which occur under natural conditions in man, there is conjunctivitis, usually slight but sometimes severe, which may extend to the inner structures of the eye. It is a well-established fact that any of them except vaccinia and chicken-pox may occur without recognized cutaneous lesions. It is quite true that the cutaneous eruption of influenza is often absent and is not clearly characteristic, as are the cutaneous lesions of the other affections of this group; but it is undeniably true that such an eruption is commonly found in the victims of the disease if looked for carefully.

In the whole group (vaccinia excepted) certain lesions of the mouth, tonsils, pharynx, larynx, and bronchi, varying from discrete or diffuse areas of congestion to definite inflammatory processes, are commonly present. When diffuse, these lesions are alike; only when discrete are they apt to present characters

pathognomonic of any particular member of the group. While victims of certain of them are not particularly prone to develop inflammatory lesions of the middle ear, accessory sinuses, tonsils, pharynx, bronchi, and lungs—often more serious than the primary affections—such lesions not infrequently occur in persons affected by the others.

In their mode of spread, chiefly if not invariably by personal contact (except vaccinia), these diseases are strictly comparable. And again, excepting vaccinia, their reaction to warm weather is in general the same. With few exceptions they all flourish only in the colder seasons, tending almost invariably when endemic to die down during warm weather, to spring up in the autumn and gather force, to reach their zenith in the winter or spring, and gradually to subside with the development of warm weather. As a rule, also, when they occur as epidemics, this general rule is adhered to.

All of them, except chicken-pox and vaccinia, have, as will appear later, repeatedly entered Baltimore as epidemics, more or less widespread and fatal, and have after a period of from one to several years, completely died out without attacking, in recognizable form, all persons of susceptible age and not previously affected. After repeated experiences of this character, small-pox, measles, scarlet fever, and influenza have become endemically established. In their known immunity reactions these diseases bear close resemblances. As a rule, in each disease, with the probable exception of influenza, one attack confers either at most complete and permanent immunity, or, at least, an immunity for a prolonged period with assurance of lightness of succeeding attacks. It is characteristic of them all, though in varying degree, that during an attack the resistance of the body as a whole, and of the respiratory tract in particular, with the exception of vaccinia, is lowered to infection with pyogenic microorganisms, especially pneumococcus, streptococus, and staphylococcus. Two of them, small-pox and vaccinia, are interchangeably protective, and the latter in practice is available as a substitute for the former. These diseases, when once established in large communities, have defied such attempts at interference with their spread as household quarantine and disinfection. Household and general sanitation, nuisance control (with the single exception of prevention of the spread of scarlet fever by means of milk), and riches and poverty, are all alike without discernible influence upon their course. Small-pox, restricted doubtless to some degree by vaccination attacks incompletely organized, worked its way effectively for many years.

All of these diseases share in common a proneness to attack the age group 1 to 20 or 30 years.

The illusive virus of each [1] has resisted discovery under repeated attacks upon its identity with the use of all the resources of the microscopic and cultural methods of modern microbiology. No one has been able to demonstrate, in relation with the characteristic lesions of any of these affections, parasites satisfactorily explaining them. In those members of this group which have proved capable of transmission to laboratory animals, the viruses have been shown to pass fine filters.

The specific virus of each member of the group appears to be able to resist drying. No convincing evidence exists that the virus of any of them requires an intermediate host either for development, preservation, or spread. The characters,

[1] See footnote, p. 44.

seats, and distributions of the essential lesions of all these diseases, as they occur under natural conditions, indicate that their viruses are spread throughout the body by means of the blood-vessels and have their primary and, in some of them, their principal effect upon the blood-capillaries. Thus they all present the typical indications of general rather than local affections. As if to emphasize these characteristics held in common by each of these diseases, with the possible exception of vaccinia, in examples of unusual severity, hemorrhages into the skin, mucous membranes, and even into certain organs are usual.

Points of difference, on the other hand, are not lacking. Vaccinia, under natural conditions, in the present age at least, is not a peculiar disease of man. Occurring, with few exceptions, only when transferred by inoculation, it is not capable of propagating itself in this species indefinitely by contact or whatsoever other means usual for diseases of this group. Again, the incubation periods of members of the group vary not only among the two divisions least alike, but among those most alike in their superficial lesions.

In their finer details, the characteristic lesions of the diseases most alike show differences which may be regarded as specific. It is unnecessary to indicate other points of difference which will be evident enough to the initiated. Enough has been brought forward to indicate that in the present discussion it is not sought to prove identity, but to establish similarity among the members of this in many ways peculiar group of diseases.

SMALL-POX.

There are no definite records of the prevalence and fatality of small-pox in Baltimore before 1811, though, judging from the accounts of its prevalence in Maryland in 1743, 1755, 1756, 1760, 1762, 1765, 1767, and 1771, and from the activity of Dr. Henry Stevenson as an inoculator, it must have frequently entered and spread in the town. In connection with the history of vaccination, it is recorded that small-pox was prevalent in Baltimore in 1800, 1801, and 1810. The considerable epidemic of 1811–1812, with death-rates of 153 and 183 respectively, was the first one of consequence in the nineteenth century. Except for a few cases in 1810, when the disease was said to have been "soon extinguished by vaccination," small-pox had been absent several years. This epidemic subsided as suddenly as it arose, and the disease did not reappear, at least in fatal form, until 1816, when there were 2 deaths. Except for 1 death in 1818 and 1819, fatal small-pox was not again recorded until 1821. It is worthy of note that, after this severe epidemic, the disease practically died out for 10 years (table 34, graph 11). The few deaths recorded between 1813 and 1821 were apparently associated with very limited outbreaks, or with isolated imported cases. It is certain that the city was free from recognized small-pox in 1820.

The epidemic of 1821–1822, with death-rates of 35 in the former and 194 in the latter year, which was as sudden and unheralded as the one of 10 years before, was traced to the importation of cases of small-pox on the ship *Pallas*. The disease died down in 1823, but there were a few deaths each year until 1830, except in 1829, with rate varying from 2 to 9. Again the former experience was repeated, though not exactly, for in some years, at least, after the subsidence of the epidemic, the disease was perhaps endemic.

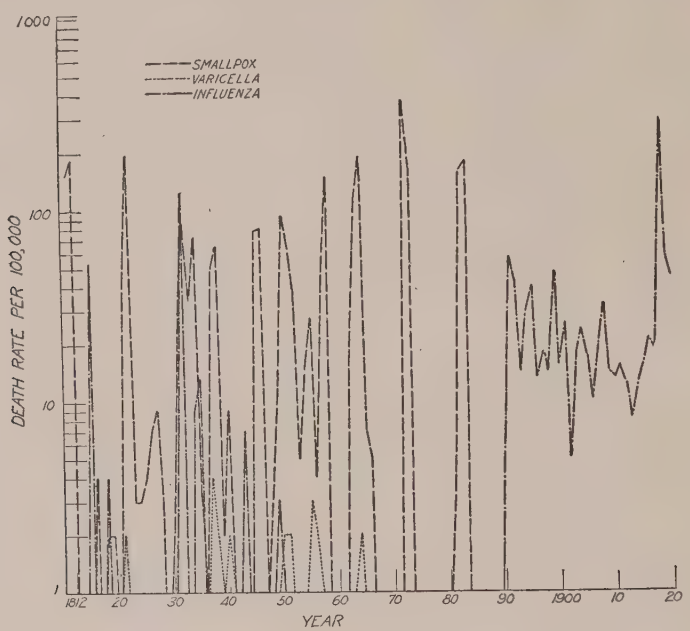
TABLE 34.—*Number of deaths and rate of death, per 100,000 living inhabitants, from small-pox, vaccinia, varicella, scarlet fever, measles, influenza, and total acute exanthematous diseases excluding vaccinia, and percentage of the total deaths, from 1812 to 1920, inclusive.*

Year.	Acute exanthematous diseases.														
	Small-pox.		Vaccinia.		Varicella.		Scarlet fever.		Measles.		Influenza.		Total (excluding vaccinia).		Per cent. of total deaths (excluding vaccinia).
	D	R	Vaccinations.	R	D	R	D	R	D	R	D	R	D	R	
1811	60	153	.....	.....	...	...	...	...	...	...	...	...	60	153	..
1812	75	183	.....	.....	...	...	...	...	...	...	...	...	75	183	6
1813	....	...	.....	.....	...	...	...	...	33	77	...	...	33	77	3
1814	....	...	.....	.....	...	...	1	2	...	...	...	...	1	2	..
1815	....	...	.....	.....	...	...	...	...	8	17	25	53	33	71	2
1816	2	4	.....	.....	...	...	...	...	7	14	...	...	9	18	1
1817	....	...	.....	.....	...	...	...	...	...	...	...	...	....	...	..
1818	1	2	.....	.....	...	...	...	...	...	...	2	4	3	6	..
1819	1	2	.....	.....	...	...	...	...	116	209	...	...	117	211	5
1820	....	...	.....	.....	...	...	4	7	...	...	...	...	4	7	..
1821	21	35	.....	.....	1	2	3	5	2	3	...	...	27	45	1
1822	122	194	.....	.....	...	...	...	...	4	6	...	...	126	201	6
1823	2	3	.....	.....	...	...	1	2	175	268	...	...	178	272	9
1824	2	3	.....	.....	...	...	...	...	14	21	...	...	16	24	1
1825	3	4	.....	.....	...	...	3	4	9	13	...	...	15	21	1
1826	5	7	.....	.....	...	...	...	...	3	4	...	...	8	11	..
1827	7	9	4019	5251	...	...	...	...	1	1	...	...	8	10	1
1828	2	3	.....	.....	...	...	...	...	...	...	...	...	2	3	..
1829	....	...	2762	3474	...	...	1	1	46	56	...	...	47	57	3
1830	2	2	.....	.....	...	...	147	172	7	8	...	...	156	182	8
1831	25	28	3398	3824	...	...	161	181	23	26	11	12	220	248	10
1832	79	86	673	730	1	1	16	17	2	2	114	124	212	230	6
1833	32	34	.....	.....	...	...	141	148	12	13	...	...	185	194	8
1834	71	72	1068	1080	1	1	143	145	77	78	9	9	300	303	12
1835	3	3	.....	.....	...	...	13	13	5	5	13	13	34	33	2
1836	1	1	130	123	...	...	30	28	1	1	...	...	32	30	1
1837	53	48	2753	2512	4	4	134	122	141	129	...	...	332	303	13
1838	72	64	1000	882	2	2	141	124	4	4	...	...	219	193	9
1839	2	2	2213	1889	1	1	112	96	57	49	...	...	172	147	8
1840	11	9	.....	.....	3	2	71	59	32	26	...	...	117	97	6
1841	1	1	.....	.....	1	1	74	59	6	5	...	...	82	66	4
1842	1	1	2655	2058	...	...	27	21	103	80	...	...	131	102	5
1843	....	...	2254	1694	...	...	56	42	4	3	9	7	69	52	3
1844	....	...	.....	.....	...	...	370	270	1	1	...	...	371	270	14
1845	110	78	3367	2379	...	...	288	204	20	14	1	1	419	296	14
1846	115	79	3707	2542	1	1	132	91	114	78	...	...	362	248	12
1847	2	1	1805	1201	1	1	166	110	7	5	...	...	176	117	5
1848	5	3	1763	1139	...	...	407	263	74	48	...	...	486	314	13
1849	20	13	2159	1355	1	1	154	97	31	19	4	3	210	132	5
1850	153	93	1987	1212	3	2	225	137	7	4	1	1	389	237	9
1851	104	62	3738	2217	3	2	234	139	21	12	...	...	362	215	9
1852	66	38	1948	1123	...	...	232	134	314	181	...	...	612	353	12
1853	9	5	1604	900	...	...	362	203	16	9	...	...	387	217	8
1854	26	14	2513	1371	1	1	234	128	99	54	...	...	360	196	7
1855	50	27	3910	2077	6	3	131	70	14	7	...	...	201	107	4
1856	8	4	2236	1156	3	2	222	115	8	4	...	...	241	125	5
1857	91	46	4121	2076	2	1	353	178	205	103	...	...	651	328	13
1858	310	152	8576	4209	...	...	535	263	39	19	...	...	884	434	16
1859	1	...	1770	847	...	...	301	144	57	27	...	...	359	172	8
1860	....	...	2277	1062	...	...	116	54	109	51	...	...	225	105	5
1861	1	...	2992	1360	3	1	252	115	11	5	...	...	267	121	6
1862	34	15	1663	737	...	...	575	255	154	68	...	...	763	338	15
1863	252	109	2862	1238	2	1	339	147	17	7	...	...	610	264	11
1864	436	184	6044	2552	4	2	136	57	143	60	...	...	719	304	13
1865	18	7	2315	954	...	...	86	35	11	5	...	...	115	47	2

TABLE 34.—*Number of deaths and rate of death, per 100,000 living inhabitants, from small-pox, vaccinia, varicella, scarlet fever, measles, influenza, etc.*—Continued.

Year.	Acute exanthematous diseases.														
	Small-pox.		Vaccinia.		Varicella.		Scarlet fever.		Measles.		Influenza.		Total (excluding vaccinia).		Per cent. of total deaths (excluding vaccinia).
	D	R	Vaccinations.	R	D	R	D	R	D	R	D	R	D	R	
1866	13	5	2076	835	1	...	121	49	105	42	...	...	240	97	4
1867	....	...	891	350	1	...	137	54	8	3	...	...	146	57	3
1868	....	...	2216	851	...	...	127	49	196	75	...	...	323	124	5
1869	....	...	1822	684	...	...	171	64	227	85	...	...	398	149	6
1870	....	...	1329	487	3	1	256	94	35	13	...	...	294	108	4
1871	....	...	5364	1923	4	1	625	224	111	40	...	...	740	265	10
1872	1043	366	50650	17756	4	1	141	49	161	56	...	...	1349	473	15
1873	469	161	87739	30084	...	...	115	39	46	16	...	...	630	216	8
1874	....	...	1136	381	3	1	234	78	93	31	...	...	330	111	4
1875	1	...	1741	571	...	...	519	170	15	5	...	...	535	176	7
1876	....	...	1634	525	...	...	562	181	16	5	...	...	578	186	8
1877	....	...	3397	1068	...	...	447	141	151	47	...	...	598	188	8
1878	1	...	1457	449	...	...	141	43	11	3	...	...	153	47	2
1879	1	...	2186	659	1	...	367	111	43	13	1	...	413	125	5
1880	1	...	8467	2501	...	...	400	118	12	4	...	...	413	122	5
1881	11	3	20100	5816	2	1	215	62	75	22	1	...	304	88	3
1882	551	156	94693	26850	...	...	179	51	71	20	...	...	801	227	9
1883	633	176	217050	60319	1	...	334	93	130	36	...	...	1098	305	12
1884	1	...	1567	427	3	1	104	28	228	62	...	...	336	92	4
1885	....	...	2012	537	...	...	68	18	16	4	...	...	84	22	1
1886	1	...	3042	797	...	...	32	8	201	53	...	...	234	61	3
1887	....	...	4066	1045	1	...	36	9	85	22	...	...	122	31	1
1888	....	...	7458	1778	...	...	44	10	176	42	...	...	220	52	2
1889	....	...	7411	1735	...	...	71	17	11	3	...	...	82	19	1
1890	....	...	11281	2596	...	...	42	10	248	57	17	4	307	71	3
1891	....	...	10703	2421	3	1	128	29	16	4	244	55	391	88	4
1892	....	...	33249	7398	1	...	258	57	120	27	190	42	569	127	5
1893	....	...	20875	4570	1	...	36	8	39	9	62	14	138	30	..
1894	....	...	42042	9059	1	...	85	18	3	1	132	28	221	48	..
1895	....	...	12990	2755	...	...	59	13	68	14	185	39	312	66	3
1896	....	...	13759	2875	2	...	31	6	27	6	60	13	120	25	1
1897	....	...	12905	2656	1	...	53	11	16	3	88	18	158	33	2
1898	....	...	11817	2397	...	...	46	9	48	10	70	14	164	33	2
1899	1	...	36491	7296	...	...	24	5	5	1	231	46	261	52	3
1900	....	...	9023	1780	...	...	20	4	24	5	77	15	121	24	1
1901	....	...	15400	2997	1	...	11	2	3	1	128	25	143	28	1
1902	7	1	46412	8913	...	...	37	7	41	8	28	5	113	22	1
1903	2	...	11566	2193	...	...	84	16	77	15	92	17	255	48	3
1904	4	1	23440	4389	1	...	143	27	6	1	122	23	276	52	3
1905	....	...	5979	1106	1	...	33	6	67	12	91	17	192	36	2
1906	....	...	9319	1703	4	1	47	9	14	3	54	10	119	22	1
1907	....	...	3769	681	...	...	15	3	74	13	105	19	194	35	2
1908	....	...	5926	1058	...	...	70	13	17	3	173	31	260	46	2
1909	....	...	1277	226	...	...	25	4	54	10	79	14	158	28	2
1910	....	...	8161	1426	1	...	49	9	19	3	72	13	141	25	1
1911	....	...	7561	1307	...	...	44	8	77	13	86	15	207	36	2
1912	....	...	4663	798	1	...	23	4	5	1	71	12	100	17	1
1913	....	...	27424	4648	...	...	40	7	118	20	48	8	206	35	2
1914	3	1	15693	2634	6	1	39	7	6	1	72	12	126	21	1
1915	....	...	7223	1201	...	...	33	5	17	3	97	16	147	24	1
1916	....	...	6515	1073	2	...	30	5	34	6	129	21	195	32	2
1917	....	...	8894	1452	...	...	11	2	51	8	108	18	170	28	2
1918	....	...	10230	1656	4	1	8	1	75	12	1741	282	1828	296	11
1919	....	...	.....	.....	4	1	30	4	7	1	406	56	447	62	4
1920	....	...	.....	.....	3	...	13	2	49	7	324	44	389	53	3

It will be well here to consider very briefly the character and extent of the protective measures against small-pox up to 1830. Inoculation against small-pox is said to have been practiced in Maryland since shortly after its introduction into England in 1717. Besides other well-known inoculators in Maryland, there was the widely celebrated Richard Brooke, of Prince George County, who devised the "American method" described in a tract published by Benjamin Franklin in 1730, and afterwards widely adopted. Dr. Henry Stevenson, one of the most successful inoculators, practiced the art in Baltimore as early as 1755, and maintained for many years an inoculation hospital in the suburbs of Baltimore Town. His charges were 2 pistoles (perhaps 32 shillings) for inoculation and 20 shillings a week for board and lodging. It is probable,



GRAPH 11 (from table 34). Annual crude mortality rates from small-pox, varicella and influenza, from 1812 to 1920, inclusive.

therefore, that on account of the cost and the scant hospital accommodations available, the protection of inoculation was within the reach of only the very well-to-do. The procedure was, however, held in high esteem, and was continued to some extent until abolished by law in 1850.

Vaccination against small-pox was first practiced in Baltimore in the summer of 1800, by Dr. John Crawford, with virus received from Ring, of London. The second supply of vaccine virus, obtained some months later from London, through Mr. William Taylor, came into the hands of Dr. James Smith, attending physician to the almshouse. On May 1, 1801, Dr. Smith vaccinated a girl of 7 years, and later a considerable number of other patients at the almshouse. It is narrated that, though all of Smith's cases were exposed to small-pox, then prevalent, none contracted the disease. Though the virus was freely offered, no one could then be prevailed upon to use it generally. In 1802, Dr. Smith

established a vaccine institute, which, in one form or another, he maintained for many years. Their first doubts removed by the success of Smith's experiments, the local physicians became ardent vaccinationists. The faculty endorsed the procedure in 1802 and again in 1805. During the small-pox epidemic of 1812 the members offered to vaccinate gratuitously all who applied and to pay 25 cents to each child presenting proof of genuine vaccination.

A lottery was granted in 1809 to extend the work of the Vaccine Institute, and in 1812 a vaccine society was organized by leading citizens. In that year the society was responsible for 994 vaccinations, 694 of which were gratuitous. About this time, too, the National Vaccine Institute was established in Baltimore under Dr. Smith's direction.

During the epidemic year 1821, at the suggestion of the faculty, a vaccine physician was appointed in each ward to vaccinate the poor, and this became a permanent feature of the public-health organization in 1824. At this time, too, the health department became responsible for having on hand a pure and potent vaccine virus. Up to 1827, administrative efforts to control small-pox by vaccination were limited to furnishing virus freely, providing free vaccination to the poor, and employing moral suasion to promote its general adoption.

In April of this year, when small-pox, introduced in virulent form by shipping, was spreading rapidly, and many, particularly among the free negroes, refused vaccination, the health department was granted power to vaccinate all persons in the neighborhood of cases of small-pox, and, in a short time, 517 persons were vaccinated under this provision. This law remained the main dependence of the health department in fighting actual outbreaks of small-pox until greater powers were conferred by the ordinance and the State law of 1864. There is no record of the number of public vaccinations prior to 1827. For this year, when the deaths from small-pox numbered only 9, the four vaccine physicians were credited with performing 4,019 vaccinations, a rate of 5,251 (table 34). For 1829 the vaccination-rate was 3,474. No record was made of the number of vaccinations for 1828 and 1830. There is little doubt that the proportion of public vaccinations was much greater after than before the conferring of greater powers upon the health department in 1827. It is probably fair to assume that during the epidemics of 1811–1812 and 1821–1822, under the influence of the propaganda conducted by the medical profession, the vaccine society, and the health department, a very considerable proportion of the better-to-do and more intelligent of the population were vaccinated at least once, and that during the last epidemic a considerable number of the poorer classes availed themselves of the services of the vaccine physicians. It is likely that by 1830 a very considerable proportion, but certainly not more than one-half, of the population had been vaccinated.

During this period the health department possessed the right to enforce isolation of small-pox cases and contacts in houses and institutions, to clean and disinfect the latter, and to destroy infected clothing, bedding, and the like. But its personnel and machinery for exercising its power were wofully deficient. Case reporting, except by tavern and boarding-house keepers and masters of vessels in the harbor, was voluntary. In times of epidemic, the few police were called upon to act as searchers and watchmen, and, though the vaccine physicians were doubtless ever on the watch for small-pox cases and must have been

in position to hear of cases seen by physicians, many hidden cases among free negroes and recent immigrants must have escaped them.

Practically speaking, there were no adequate hospital facilities. The small hospital building at Hawkins' Point was distant and difficult of access. The accommodations at the lazaretto were scanty and not sufficient to care for patients and suspects from the extensive shipping.

While small-pox was certainly included in the list of "pestilential diseases" against which maritime quarantine applied, time and again cases filtered through the wide meshes of its sieve. Quarantine by land was not attempted.

The conclusion is inevitable that the course of small-pox in Baltimore during the period under consideration was not materially influenced by artificial interferences of the ordinary sort, and that during the period previous to 1827 the natural history of the disease could not have been very seriously modified by vaccination.

The year 1831 ushered in a new phase which lasted until 1866. During the period of 36 years in only four years were deaths not recorded, and probably in no year did the city lack cases. Very characteristic of this period was the occurrence of numbers of outbreaks or minor epidemic waves with low mortality rates as compared with the previous epidemics and extending over from 2 to 4 years. The intervals between the outbreaks varied from one to several years. It appears that during most of this period small-pox was endemically established, and that these repeated outbreaks were due in part to exacerbations of the indigenous disease and in part to new importations.

The first of these minor outbreaks, extending over the 4 years 1831–1834 ran a somewhat irregular course, with rates of 28, 86, 34, and 72 for the several years. The rates dropped abruptly to 3 in 1835 and to 1 in 1836. This outbreak was, to some degree at least, modified by administrative measures. A small hospital for small-pox cases had been established within the city, and vaccination, with virus renewed by "passage" through a cow, was pushed. According to Dr. Jameson's report, 6,000 persons were vaccinated in 1831, though the official number credited to the vaccine physicians was under 4,000. Unfortunately, the figures for vaccination were not given in the reports for 1833 and 1835. The vaccination-rates for 1832, 1834 and 1836 are very low. Dr. Jameson attributed the continued prevalence of small-pox to the fact that many persons who had been properly vaccinated in childhood neglected vaccination at puberty. His demand for general compulsory vaccination was not granted.

The second wave, marked by rates of 48 in 1837 and 64 in 1838, subsided in 1839, and in two of the following four years no deaths were recorded. The vaccinations were recorded too irregularly to permit judgment in regard to their effect upon the disease at this time. There were flare-ups of the disease with moderately high death-rates in 1845–1846, 1849–1852, and 1854–1855. The vaccination-rate was relatively high only in 1845, 1846, 1851, and 1855. After 1846, a considerable number of small-pox cases were sent to the new Marine Hospital, and as the deaths among these were not credited to the city, the mortality rates calculated on the official figures after this date are lower than actual experience.

The considerable epidemic of 1857–1858, with rates of 46 and 152, was associated with a high vaccination-rate (4,209) in the latter year. With the

subsidence of this outbreak the disease lay dormant until 1862, when there began a serious epidemic which lasted over the Civil War. Death-rates of 109 and 184 were attained in 1863 and 1864. The vaccination-rates were relatively low—2,552 in 1864 being the highest.

During much if not most of this period the administrative measures designed to control the spread of the disease were very lax. As late as 1857 complaint was made in the annual report that vaccination was very incomplete, that unvaccinated persons in the incubative stage of small-pox moved at will from infected to non-infected districts, and that convalescents were freed from quarantine too early. As evidence of the insufficiency of the system of non-compulsory vaccination in effect, it was pointed out that in December 1857, in the midst of an epidemic, in 1,173 calls at houses the vaccinators performed only 1,637 vaccinations. The weakness of the administration's position is evident from the fact that this number comprised nearly half the public vaccinations performed that year.

The conferring of greater powers to the health department by the city government, and the establishment by the State legislature of compulsory vaccination of children before the end of the first year and the State vaccine agency, all in 1864, were reflections of the severe epidemic of 1862–1864. Strangely little allusion was made to the epidemic of the Civil War period, Fortunately, Charles Frick published, in 1855, data from which may be drawn a clear picture of the distribution of deaths from small-pox by color, sex, and age. In his analysis of the deaths from small-pox for the year 1850 in Baltimore, Frick, who had access to the original records, found that, for the whites the deaths were 8.1 and for the blacks 14.5 to 10,000 inhabitants, or nearly double among the latter race. The disease was more fatal to males than to females in the proportion of 60.6 per cent of the first to 39.4 per cent of the latter. The proportion of the deaths, at different ages, is shown in table 35.

TABLE 35.

	p. c.
Under 1 year	18.0
Between 1 and 5 years	30.8
Between 5 and 10 years	7.5
Between 10 and 20 years	7.7
Between 20 and 30 years	17.0
Between 30 and 60 years	17.3
Over 60 years	1.7

The death-rates specific for age are given in table 36.

The high rates obtaining among infants and young children indicates that the routine vaccination of children in the first or second year of life had not yet become a general custom in the community.

After an absence of 4 years, small-pox made its appearance in Baltimore in November 1871, following the importation of a case from Philadelphia, where the disease was prevalent in severe form. There were no deaths registered in 1871, but in January and February 1872 there were 1 and 14 deaths respectively. Thus by March there was well under way an epidemic which lasted until July 1873, and which proved to be the severest in the city's history. The course of the disease as marked by the monthly annual mortality rates is well shown on table 37. The dip in the curve during August, September, October,

and November 1872, may be ascribed partly to the well-known influence of season and partly to the efforts of the health department, particularly in pushing vaccination. However this may be, after a very rapid and steep ascent, the highest peak in the curve was reached in July 1872, with a monthly annual death-rate of 1,081. This was followed by the abrupt fall to a relatively low level for 4 months, which in turn was succeeded by a sharp rise, beginning in December and reaching its high point in January 1873, with a monthly annual rate of 755. From this point there was a gradual fall with the culmination of the epidemic in July. The annual death-rates for 1872 and 1873 were 366 and 161, respectively. This picture is, however, only relatively and not actually correct, for it is drawn from rates calculated only on the deaths that occurred within the city, no account being taken of the considerable number of deaths among city cases sent to the Marine Hospital or pest-house without the city

TABLE 36.—*Number of deaths and rate of death, per 100,000 living inhabitants, from small-pox and scarlet fever, according to age, for 1850. Calculated from figures given in Frick's tables.*

Age period.	Small-pox.		Scarlet fever.	
	D	R	D	R
Under 1 year	28	457	24	392
1 to 4 years	48	260	134	727
5 to 9 years	12	60	45	224
Under 10 years	88	197	203	455
10 to 19 years	11	30	21	57
20 to 29 years	26	76	1	3
30 to 39 years	11	45	...	...
40 to 49 years	14	96	...	...
50 to 59 years	3	37	...	...
60 years and over	3	47	...	...
Total	156	92	225	133

limits. These included many of the worst cases, some of which were moribund on their arrival. As separate accounts were not reported of the cases and deaths of citizens of Baltimore and of the sailors and passengers with small-pox removed at quarantine from foreign ships and sent to the Marine Hospital, it is not possible to determine the number of deaths among the former at that institution. During the period of the epidemic there were treated at the Marine Hospital a total of 1,016 cases of small-pox with 533 deaths and 246 cases of varioloid with 6 deaths, and the great majority at least of these occurred in persons sent from the city. There were at the hospital, 682 cases of small-pox with 316 deaths in 1872 and 334 cases with 217 deaths in 1873 and 124 cases of varioloid with 6 deaths in the former year and 122 cases and no deaths in the latter. The proportional distribution of the deaths of small-pox in the city (1,043 in 1872 and 469 in 1873) and at the hospital in these two years was in the neighborhood of 3 to 1 in 1872 and 2 to 1 in 1873. When the number of deaths occurring at the Marine Hospital—nearly all among patients sent from the city—are added to the figures as given in the official list, the total number

TABLE 37.—*Number of deaths by months and years and monthly annual and annual rates of death, per 100,000 living inhabitants, from small-pox, from 1856 to 1920, inclusive.**

D = death. R = rate.

Year.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1856	3	18	...	...	...	...	...	...	...	...	1	6	3	18	...	...	1	6	...	...	...	...	...	...	8	4
1857	1	6	...	...	1	6	...	...	...	...	2	12	7	42	6	36	3	18	10	59	25	153	36	214	91	46
1858	67	387	69	441	76	439	35	209	27	156	20	119	9	52	2	12	...	...	2	12	2	12	1	6	310	152
1859	...	....	...	...	...	...	...	...	1	6	...	....	...	....	...	...	...	...	...	...	...	...	...	...	1	...
1861	...	....	...	...	...	...	...	...	1	6	...	....	...	....	...	...	...	...	...	...	...	...	...	...	1	...
1862	...	....	3	17	3	16	5	27	6	31	3	16	...	....	1	5	1	5	...	...	6	32	6	31	34	15
1863	3	15	5	28	18	92	25	132	16	82	18	95	19	97	16	82	10	53	12	61	36	190	74	377	252	109
1864	87	432	116	638	68	338	71	365	38	189	21	108	10	50	10	50	6	31	5	25	1	5	3	15	436	184
1865	6	29	3	16	4	19	2	10	...	...	...	....	1	5	...	...	...	...	...	...	1	5	1	5	18	7
1866	...	....	4	21	2	9	6	29	...	...	1	5	...	....	...	...	...	...	...	...	...	...	...	...	13	3
1872	1	4	14	64	16	66	74	316	150	619	241	1028	262	1081	61	252	40	171	36	149	38	162	110	454	1043	366
1873	187	755	136	608	85	343	27	113	23	93	8	33	3	12	...	...	...	...	...	...	...	...	...	...	469	161
1875	...	....	...	...	...	...	...	...	...	...	...	....	...	....	1	4	...	...	...	...	...	...	...	...	1	...
1878	...	....	...	...	...	...	...	...	1	4	...	....	...	....	...	...	...	...	...	...	...	...	...	...	1	...
1879	...	....	...	...	...	...	...	...	...	...	1	4	...	....	...	...	...	...	...	...	...	...	...	...	1	...
1880	...	....	1	4	...	...	...	...	...	...	...	....	...	....	...	...	...	...	...	...	...	...	...	...	1	...
1881	...	....	...	...	...	...	...	...	1	3	1	4	...	....	...	...	...	...	...	...	...	...	...	...	1	...
1882	2	7	6	22	10	33	12	41	17	57	13	45	22	73	24	80	71	245	63	210	94	324	217	724	551	156
1883	329	1076	194	703	65	213	28	95	12	39	4	14	1	3	...	...	...	...	...	...	...	...	...	...	633	176
1884	...	....	...	...	...	...	...	...	...	...	1	3	...	....	...	...	...	...	...	...	...	...	...	...	1	...
1886	...	....	...	...	...	...	...	...	...	...	1	3	...	....	...	...	...	...	...	...	...	...	...	...	1	...
1899	...	....	...	...	1	2	...	...	...	...	...	....	...	....	...	...	...	...	...	...	...	...	...	...	1	...
1902	...	....	...	...	3	7	2	5	...	...	1	2	...	....	...	...	1	2	...	...	...	...	...	...	7	1
1903	...	....	...	...	...	...	1	2	...	...	...	....	...	....	...	...	...	...	1	2	...	...	...	...	2	...
1904	...	....	...	...	...	...	...	...	3	7	1	2	...	....	...	...	...	...	...	...	...	...	...	...	4	1
1914	...	....	...	...	...	...	2	4	...	...	1	2	...	....	...	...	...	...	...	...	...	...	...	...	3	1

* Those years in which deaths did not occur have been omitted from this table.

of deaths attributable to small-pox was 1,365 in 1872 and 686 in 1873, and the mortality rates are raised correspondingly to 479 and 235, respectively.

Data for the calculation of morbidity rates and case-fatality rates in the city are unfortunately lacking. The commissioner of health, writing 10 years later, stated that in this epidemic, without compulsory reporting, 4,000 cases of small-pox were discovered and probably as many again were concealed; 6,000 cases would therefore be a conservative estimate. According to the report of the physician at the Marine Hospital, the case-fatality rate was 63 per cent among the unvaccinated, and 14 per cent among those who had been vaccinated. Only 3 deaths occurred among individuals having "good" vaccination marks. The total case-mortality rate for all ages was 40 per cent in 1872 and 42 per cent in 1873. He calculated the case-mortality rates as affected by age for both years. As the results are almost identical, those for 1872 are given in table 38.

The high fatality-rate among the hospital cases was attributed to five sets of causes: Distant transportation over rough roads, the moribund condition of many patients on arrival, the preponderance of negroes, the high proportion of persons of the poorest conditions of life, and the imperfection of the accommodations provided. The majority of the patients had never been vacci-

TABLE 38.

	p. c.
Under 10 years	48
10 to 19 years	35
20 to 29 years	38
30 to 39 years	43
40 to 49 years	35
50 to 59 years	52
60 to 69 years	66
70 to 79 years	60

nated; a large number said they had "been vaccinated, but it never took"; and a third class, in whom the disease was lightest, were those who had been vaccinated successfully in childhood. Those with good and recent vaccination scars did not have the disease severely enough to confine them to bed. The favorable effect of a previous attack of small-pox and of previous successful vaccination upon the fatality-rate is shown by the low fatality-rates in varioloid, 2 per cent, and in the previously vaccinated, 14 per cent.

The campaign of the health department, organized in March 1872, embraced (1) the reporting each morning by every policeman to his district station of the cases discovered on his beat; (2) the prompt investigation by a medical officer of the health department detailed to each of the four police stations of the new cases reported in the district; (3) the employment of the sanitary inspectors to dispatch all cases willing to submit to it to the Marine Hospital, to establish isolation in the homes of cases not so disposed of and in those of all contacts, and to supervise disinfection of houses, clothing, and furniture; and (4) the vaccination by the regular vaccine physicians of everyone who would submit, whether previously vaccinated or not, dwelling or working in the immediate neighborhood of reported cases. When, despite these efforts, the disease continued to make rapid headway, a number of extra vaccine physicians were ordered to enter each house in the city, and, "baring every arm, to vaccinate everyone without unmistakable evidence of thorough protec-

tive vaccination," whom they could persuade or bluff into permitting it. This group of vaccinators are reported to have made in these two months 33,911 separate calls and 11,866 vaccinations, of which 2,536 were primary, 9,075 were secondary, and 255 unclassified. The regular vaccine physicians were credited between November 1, 1871, and October 31, 1872, with 49,028 calls and 38,784 vaccinations, of which 10,065 were primary, 28,240 were secondary, and 479 unclassified. So in this period, covering the first 12 months of the epidemic, public vaccinators visited 82,939 dwellings and performed 50,650 vaccinations, of which 12,601 were primary, i. e., in persons never before vaccinated; 37,315 were secondary, i. e., in persons who had been vaccinated previously; and 734 were not classified. Of a total of 19,356 vaccinations inquired into for success or failure, 14,045 were recorded as successful. With the marked increase of the disease in January 1873, the intensive campaign of vaccination was renewed, and for the next 6 months a corps of 80 physicians assisted the regular vaccine physicians. Between November 1, 1872, and October 31, 1873, but for the most part between January and July 1873, these two groups made 96,693 calls, with 87,739 vaccinations, of which 7,330 were classed as primary and 80,409 as secondary. Thus, during this period of Baltimore's greatest epidemic of small-pox, the 20 months between November 1871 and July 1873, inclusive, there were made by public vaccinators 179,632 calls, 138,389 vaccinations, of which 19,931 were classified as primary and 117,724 as secondary. In other words, the calls were in proportion of nearly 4 to each family, the vaccinations nearly 1 for each 2 persons in the population, and about one-sixth of the vaccinations were primary and five-sixths secondary.

It is not improbable that many of the secondary vaccinations were in individuals who had been inoculated with vaccine material but not successfully, some in childhood and others since, and even during the epidemic, and are therefore not to be considered as true revaccinations, i. e., vaccinations of persons who had previously undergone successful vaccination. From these figures it would appear that somewhat less than half the individuals of the average population for these two years (138,000 out of 287,000) were accounted unprotected by previous vaccination, and that of these nearly 20,000, or about 7 per cent, had never been vaccinated.

Early in the epidemic it was determined that the virus furnished by the State was not potent, and new virus was obtained from other sources. It is known that many of the vaccinations were made with "crusts," which, in the opinion of the commissioner of health, were often not so cut that the virus would be properly applied. To what extent vaccination was carried on by private physicians is not known, but it is not unlikely that the number covered a large proportion of those found with satisfactory vaccination marks. A factor that militated against frequency of private vaccinations even among a considerable proportion of the more intelligent and better-to-do portion of the population was the fact that a large moiety of the special vaccine physicians were men of prominence, to whom their regular patients would have applied had they not received the same services from them in their public capacity. By the end of this epidemic, all but a small proportion of the population had been submitted to vaccination.

During the years 1874 to 1880, the city was almost free from small-pox. Though there was a death from the disease in 4 of the 7 years, it showed no

tendency to spread. In 1881, small-pox was credited with 1 death in May and another in June, after which the disease apparently died out. It reappeared in November, causing 5 deaths each in this month and in December, and this marked the beginning of a severe epidemic that lasted until July 1883. Between January 1882, and the latter date there were reported 4,939 cases and 1,184 deaths within the city, and to these there are to be added the 359 deaths among the 1,053 patients sent from the city to the Marine Hospital during the epidemic. Through the 13 months from January 1882, as is strikingly shown in tables 37 and 39, the disease grew in incidence and in fatality in steady and almost uninterrupted progression, apparently uninfluenced by season or by vaccination. The curves for morbidity and mortality would correspond even more closely were it possible to add the deaths occurring at the hospital properly distributed as to date of occurrence. After January 1883, the descent of the

TABLE 39.—*Monthly morbidity and mortality, and respective rates, per 100,000 living inhabitants, from small-pox, during the epidemic, 1882-1883.*

C = cases. D = death. R = rate.

	1882				1883			
	C	R	D	R	C	R	D	R
Jan.	46	154	2	7	1259	4119	329	1076
Feb.	53	196	6	22	542	1964	194	703
Mar.	38	127	10	33	175	573	65	213
Apr.	78	269	12	41	92	311	28	95
May	107	357	17	57	35	115	12	39
June	106	366	13	45	9	30	4	14
July	114	381	22	73	2	7	1	3
Aug.	237	791	24	80	....	....	....	....
Sept.	255	880	71	245	....	....	....	....
Oct.	362	1209	63	210	....	....	....	....
Nov.	483	1666	94	324	....	....	....	....
Dec.	946	3158	217	724	....	....	....	....
Total	2825	801	551	156	2114	587	633	176

curves is rapid, such as would have occurred had the disease used up its available material or had its progress been checked by definite interference. It is evident that this epidemic was by no means so severe as that of 1872–1873 as expressed in death-rates.

This epidemic was fought by the same commissioner of health and, with two important additions, with the same means and methods. The only differences were that in October 1882 small-pox was made reportable, and the commissioner of health was given broad powers to enforce vaccination and revaccination, to compel isolation and hospitalization of those sick with small-pox, to control funerals, to restrict the use of public vehicles, and to disinfect dwellings, furniture, and clothing. Only 8 years before a very general vaccination, which must have embraced at least two-thirds of the population, had been practiced, and under the influence of the slight outbreak of small-pox in May and June and the reappearance of the disease in November and December 1881, vaccination, as is shown by the decided rise in the vaccination-rate, was stimulated.

In March 1882, and after the epidemic was well under way, the commissioner of health started his force of regular vaccine physicians, now increased to 17 in number, on house-to-house visits in accordance with the established custom to vaccinate and revaccinate those who would submit. Apparently unaffected by the measures employed or by the season, the number of cases and deaths continuing to mount, 52 extra vaccine physicians were employed in August and September. The slight lag in the curves of morbidity and mortality in October may be taken to reflect some restraining influence attributable to this activity, but such, if present, was only temporary. The extra vaccine physicians were called into action again in December, now with compulsory powers. In the calendar year the regular vaccine physicians were credited with 40,226 calls and 53,290 vaccinations, of which 13,553 were primary and 39,737 were secondary. Of these vaccinations, 15,954 were in colored and 37,336, in whites, or in a proportion of nearly 1 to 2 where the proportion of colored to white in the population was 1 to 5.5. Of 20,935 vaccinations investigated as to success or failure, 15,528 were recorded as successful. The extra vaccine physicians performed 41,403 vaccinations, of which 4,652 were primary. In January 1883, previous efforts having failed to check the disease, 50 additional vaccine physicians were appointed, making 119 vaccine physicians, all under the charge of Dr. I. E. Atkinson, as supervisor of vaccinations. Furnished with a new supply of the "purest animal virus, the large force of physicians was massed in those localities where the disease prevailed to the greatest extent, visiting every house consecutively, baring every arm, and vaccinating and revaccinating everyone, old and young, that did not present unmistakable evidence of recent, thorough, and protective vaccination." This time, under the direction of a talented and trained clinician, fearless and determined, fortified now with the requisite legal powers, vaccinations were performed *nolens, volens.* When by March there was a marked diminution of the numbers of reported cases and deaths, two-thirds of the extra force was discharged. The spread of the disease declined rapidly and the last case was discharged in July. In this year, and chiefly during the first 6 months, the regular vaccine physicians performed 26,673 vaccinations, 2,628 of which were primary and 24,045 were secondary, while the extra vaccine physicians performed 190,377 vaccinations, of which 15,236 were primary and 175,141 were secondary.

Some idea of the extent of vaccination in the city at this time is conveyed by the following figures: In a total population of 352,674, the public vaccinators, regular and extra, vaccinated between January 1, 1882, and July 1, 1883, some 311,743 persons (or the whole population with the exception of 40,931), and of these, 38,697 were primary and 273,046 were secondary vaccinations. A large proportion of the 40,931 persons not so vaccinated were presumably passed by the public vaccinators because they had been recently vaccinated successfully by private physicians. Therefore, disregarding these, only about 12 per cent of the 311,743 persons covered by the records had never been vaccinated. So it would appear that at that time vaccination had been so widely practiced that between 85 and 90 per cent of the population had been submitted to apparently successful vaccination. Of the 79,963 vaccinations (16,181 primary, and 63,782 secondary) performed by the regular vaccine physicians, 28,847 were investigated as to success or failure, and of these 21,930 were recorded as successful and 6,917 as unsuccessful, whence it would appear that if all the

primary vaccinations be granted to be successful, 5,749 of the 63,782 secondary vaccinations, or about 9 per cent, "took" and consequently something like 10 per cent of the previously vaccinated members of the population were susceptible to small-pox on exposure. Now, of the 4,939 cases of small-pox reported during this epidemic, 2,858, or about 58 per cent are recorded to have occurred among those previously vaccinated, and 2,081, or 42 per cent, among the unvaccinated; so if the 40,000-odd persons presumably vaccinated by private physicians be apportioned as unvaccinated and previously vaccinated as 1 to 7 respectively, there would have been in the population approximately 43,697 persons of the former and 59,574 of the latter category (arrived at as follows: Total number of primary vaccinations 38,697+5,000=43,697, and 9 per cent of 273,046= 24,574, and 24,574+35,000=59,574), from which it would appear that the attack-rate was 6,540 per 100,000 persons among the non-vaccinated and 3,493 per 100,000 among persons previously vaccinated but whose immunity had lapsed. Of the 2,858 cases among those previously vaccinated there was a fatality of 327, or 11 per cent, and of the 2,081 cases among the non-vaccinated, 839, or 40 per cent, the total rate being 24 per cent. These rates for non-vaccinated and for total, at least, are lower than the true rates, for in calculating them the deaths occurring among those sent to the Marine Hospital were not included in the tables of the commissioner of health. Including the 359 deaths among the 1,053 cases sent to the Marine Hospital in 1882 and 1883, the total fatalities were 1,543, with a case fatality of 31.3 per cent. During this epidemic the case-fatality rate among the cases at the Marine Hospital was decidedly lower than in the epidemic of 1872–1873.

Twenty years elapsed (1902) before there was a serious threat of epidemic small-pox, and in only three of these years (1884, 1886, and 1899) were there deaths registered against this disease in the city. In each of these years there was a single death. However, there were during these 20 years numerous occasions when cases were imported and the disease spread to a few contacts. Such cases were almost invariably sent to the quarantine hospital and the deaths among them not charged to the city. Mortality-rates averaged for 5- and 10-year periods are given in table 43 (page 301) and graphs 12 and 16.

Only since 1899 are the records of reported cases given in the annual reports. The morbidity reports from this date (table 40) show, however, that in but a single year (1916) has the disease failed to show itself. In some years, as in 1902 to 1904 and in 1913 to 1914, the number of reported cases has been sufficient to warrant the use of the term epidemic.

It will be noted that beginning with 1890 there was for some years a marked increase in the vaccination-rates. These reached rather high levels in years of actual or threatened epidemic. The State law regarding the admission of unvaccinated children to schools remained a dead letter until after the inauguration of school inspection in 1908.

From the monthly tables of reported cases since 1899 (table 40) and of deaths from 1856 to 1914 (table 37), and the monthly annual rates calculated therefrom, the influence of season on the incidence and mortality from small-pox is clearly shown. With hardly an exception, the heaviest morbidity has been in the cold months, and a characteristic of the course of the disease, when present, has been a rise in incidence and death-rates during the fall to an acme

TABLE 40.—*Morbidity by months and years and the monthly annual and annual rates of morbidity, per 100,000 living inhabitants, from small-pox, from 1897 to 1920, inclusive.**

C = cases. R = rate.

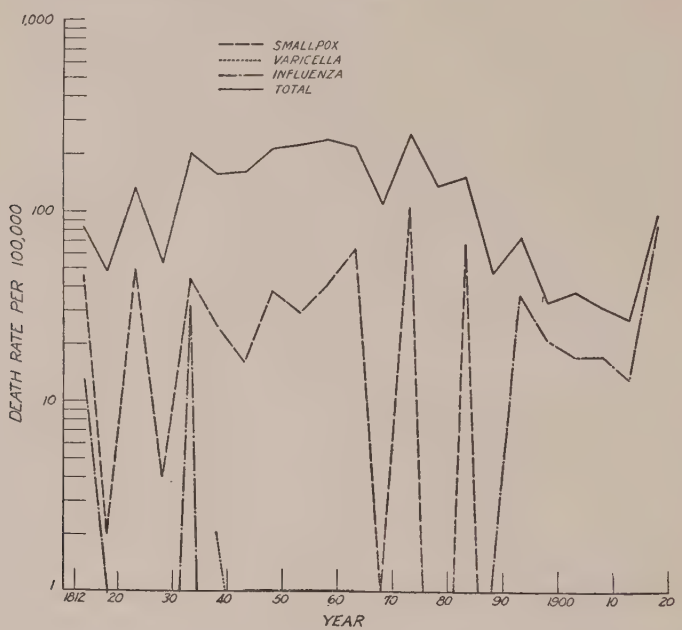
Year.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.	
	C	R	C	R	C	R	C	R	C	R	C	R	C	R
1899	2	5	2	5	7	16	2	5	3	7	...	...	1	2
1900	...	...	...	...	...	...	9	22	2	5	3	7	1	2
1901	3	7	1	3	4	9	1	2	2	5	1	2	...	...
1902	...	...	14	35	3	7	3	7	5	11	...	...	1	2
1903	2	4	6	15	10	22	5	12	13	29	1	2	1	2
1904	1	2	4	10	9	20	14	32	20	44	10	23	...	...
1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1906	14	30	19	45	14	30	9	20	2	4	...	...	...	...
1907	...	...	2	5	...	...	...	...	...	...	1	2	...	...
1908	1	2	2	5	...	...	1	2	1	2	...	...	1	2
1909	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1910	...	...	...	...	1	2	1	2	...	...	...	...	...	...
1911	...	...	...	...	1	2	...	...	...	...	...	...	...	...
1912	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1913	27	54	13	287	1	2	...	...	2	4	1	2	2	4
1914	29	57	82	179	143	283	44	90	15	30	11	22	1	2
1915	...	...	...	...	12	23	...	...	...	...	...	...	...	...
1917	...	...	2	4	7	13	3	6	...	...	...	...	...	...
1918	7	13	5	11	10	19	10	20	9	17	5	10	...	...
1919	...	...	1	2	9	15	4	7	3	5	...	...	1	2
1920	4	6	5	9	2	3	10	17	6	10	4	7	1	2

Year.	Aug.		Sept.		Oct.		Nov.		Dec.		Total.			Per cent. case fatality.	
	C	R	C	R	C	R	C	R	C	R	C	R	Average rate of morbidity by 5-year periods.	Annual.	Average by 5-year periods
1899	...	...	...	...	...	...	...	...	1	2	18	4	.....	6	.....
1900	1	2	...	...	...	...	...	...	1	2	17	3	2	.....	1
1901	...	...	...	...	...	...	1	2	1	2	14	3	.....	.....	.....
1902	...	...	2	5	...	...	...	...	1	2	29	6	.....	24	.....
1903	...	...	1	2	1	2	...	...	1	2	41	8	.....	5	.....
1904	...	...	...	...	...	...	...	...	...	...	58	11	.....	7	.....
1905	...	...	...	...	...	...	3	7	19	41	22	4	6	.....	7
1906	...	...	...	...	...	...	...	...	...	...	58	11	.....	.....	.....
1907	...	...	...	...	...	...	...	...	1	2	4	1	.....	.....	.....
1908	...	...	...	...	...	...	...	...	...	...	6	1	.....	.....	.....
1909	...	...	...	...	...	...	...	...	2	4	2	...	.....	.....	.....
1910	...	...	...	...	...	...	...	...	...	...	2	...	3	.....	.....
1911	...	...	...	...	...	...	...	...	...	...	1	...	.....	.....	.....
1912	...	...	...	...	...	...	4	8	11	22	15	3	.....	.....	.....
1913	...	...	3	6	...	...	...	...	1	2	50	8	.....	.....	.....
1914	...	...	...	...	...	...	...	...	...	...	325	55	.....	1	.....
1915	...	...	...	...	...	...	...	...	...	...	12	2	14	.....	.....
1917	...	...	...	...	...	...	1	2	10	19	23	38	.....	.....	.....
1918	...	...	...	...	...	...	...	...	...	...	46	7	.....	.....	.....
1919	...	...	...	...	...	...	...	...	...	...	18	3	.....	.....	.....
1920	2	3	...	...	...	...	...	...	...	...	34	5	10	.....	.....

* Those years in which cases did not occur have been omitted from this table.

in the winter or spring, followed by a decline to a low point, even to complete disappearance, during the hot weather.

The well-known association of increase in the spread and virulence of small-pox with wars suggests examination of the recorded experience of Baltimore in this connection. For this purpose it will be convenient to compare the time relationships of the chief local epidemic outbreaks with the occurrence of wars in America and elsewhere. The epidemic of 1811 to 1812 coincides with the Napoleonic wars in Europe, and the last year with the first year of the Anglo-American War of 1812–1815. No great war was being waged in Europe or America just previous to 1821. The uprising in Europe in connection with Belgium and the beginning of the struggle of Italy for freedom correspond



GRAPH 12 (from table 43). Crude mortality rates from small-pox, varicella, and influenza, averaged by 5-year periods, from 1812 to 1920, inclusive.

with the outbreak of small-pox in 1831–1834, and the Italo-Austrian struggle may be cited in relation to that of 1837–1838. The epidemic of 1845–1846 preceded our war with Mexico; that of 1849–1852 followed closely it and the disturbances in Europe in 1848; and the epidemics of 1854–1855 and 1857–1858 occurred shortly after the Crimean War and the accentuation of the Italian struggle. There was a distinct coincidence between the epidemics of 1862–1865 and 1871–1873, and the American Civil and the Franco-Prussian Wars, respectively. The great outbreak of 1881–1883 may possibly have been related to increased prevalence of small-pox in association with the Russo-Turkish War, and the Balkan troubles and the British attack on Egypt, and it is likewise possible that there was a relationship between the slight epidemic of 1902–1904, and 1912–1914 with the Spanish-American War of 1898 and the Anglo-Boer War of 1899–1902, and the Balkan Wars of 1912.

However, the coincidence in time between two events is only suggestive and falls far short of proof that one holds a causal relationship to the other. There is little doubt that the Napoleonic Wars were responsible for spreading small-pox over central Europe and thence to America, that small-pox in virulent form spread widely in Europe and in America during and after the Franco-Prussian War, and that in both instances the troops were primarily responsible for spread of this disease. That there was considerable small-pox for a time in the American Civil War and that Baltimore was favorably situated for infection is true, and it is very likely that the local epidemic of that time, in some measure at least, was of this origin. However, until the last two decades of the nineteenth century, small-pox was prevalent in many countries in Europe, and particularly those countries from which immigrants come to Baltimore; and furthermore, Europe was rarely entirely free from war.

The history of small-pox in Baltimore presents some striking features from which may be drawn instructive information in regard to the natural history of the disease and valuable lessons in public-health administration. The first concerns the endemic and epidemic states of the disease in the community. While it is true that, unlike other members of the group, from the earliest times its natural course has been modified by artificial interferences with its entrance and spread in the city, enough is known of the value of these at different periods to allow for their discount with some measure of certainty. Between 1800 and 1830, when the use of inoculation and of vaccination were comparatively restricted and quarantine and general methods designed to prevent its spread among the inhabitants were of the most meager sort, the disease occurred repeatedly in small and twice in large outbreaks without becoming endemically established. On the other hand, between 1831 and 1866, in association with much wider use of vaccination and of restrictive measures of a general sort, small-pox was very commonly, if not constantly endemic. During this period upon this endemic state there were imposed a number of periodic epidemic waves, which were not usually associated with mortality rates as high for individual years as were those experienced before and later. Between 1867 and 1883 this phase was succeeded by a return to the conditions prevailing before 1830, when the disease was no longer endemically established, but appeared only from time to time, with two very serious epidemics (1872–1873 and 1882–1883) separated by an interval of 10 years.

These two epidemic visitations, with mortality rates, when proper allowances for deaths occurring at the small-pox hospital are made, much higher than ever before experienced, occurred after a period of increased public vaccination-rates, the establishment of a State vaccine institution for the propagation of potent virus, the passage of State laws requiring compulsory vaccination of infants, and the exclusion of unvaccinated children from school. As neither of these legal provisions was systematically obeyed (the commissioner of health discarded the State virus as impotent in 1872), any effects which would in theory be credited to them must be largely discounted in practice. However, in spite of these activities as planned and executed and of the most active and widespread vaccination campaigns ever conducted in the city, these two epidemics lasted for the usual period of 18 or 20 months and, relative to the population, were even severer in degree than any of their predecessors.

Since 1884, small-pox has taken on a new phase, one which is without parallel in previous experience. Though introduced many times, and since 1897 present each year, the disease has not acquired endemic status and has only twice (1902–1904 and 1912–1914) threatened to become seriously epidemic. While, owing to the fact that most of those ill of the disease have of late years been removed to quarantine hospitals without the city, the deaths officially credited to small-pox by no means represent the actual fatality; nevertheless, the number has been small, and in comparison with earlier periods almost negligible. During this period vaccination has increased, virus has been greatly improved, and case-reporting and isolation have been secured. Another factor of considerable importance is that since 1884 the bulk of the European immigrants has come from countries where vaccination was enforced, while previous to this date the contrary was the case. Since 1900, at least, the disease has been introduced almost entirely by negroes from the South, and has been largely confined to this race.

It is of considerable interest that severe epidemic outbreaks have tended to occur at about 10-year intervals falling at or near the beginning of decennia, as in 1811, 1821, 1831, 1850, 1862, 1872, 1882, 1902, and 1912.

It seems clear that until 1884 the prevalence and mortality of small-pox were governed to a much greater degree by its inherent natural characteristics in their relation to the population, than by any artificial interferences, including vaccination, that were interposed. It appears that before 1900 the course of the disease could have been only modified and not controlled by vaccination as practiced.

When the curves of the rates for small-pox mortality and public vaccination incidence are compared, it is evident that, as a rule to which there are striking exceptions, vaccination was considerably stimulated by the unusual presence of small-pox.

The want of perception on the part of the people in withholding from the health department powers which experience had repeatedly shown to be necessary for adequate protection against small-pox is one of the most important features in the public-health history of Baltimore. Though almost always under the shadow of this dread disease and frequently experiencing severe epidemics, and with ample evidence that the voluntary system was a failure, it was only by gradual stages that the compulsory system was adopted. Not until 1882 was the commissioner of health given the powers demanded as essential by Dr. Jameson in 1832, and not until 30 years later was vaccination generally enforced to a point of reasonable but still far short of perfect security against small-pox. As a matter of fact, it was not until over 100 years after the discovery of vaccination and the introduction of the method in Baltimore that it was given a test even approximately fair.

The proposal in 1820 to make small-pox cases compulsorily reportable was successfully restrained by the physicians, and this evidently reasonable procedure was postponed until 1882.

Hardly less reprehensible was the inhuman treatment of the poor victims of small-pox who were dragged in rough wagons over rougher roads in all weathers to the " Marine Hospital," which, according to the mistaken idea of the times, was situated in the most inaccessible of places. It is no wonder that some

perished on the way and that many were moribund on arrival. Less barbarous, but equally unnecessary, has been the later custom still in vogue of transporting small-pox patients by water to the present quarantine station, where the accommodations furnished by the city can scarcely be dignified by the term hospital.

It will be understood that, before 1827, the vaccinations performed by the public vaccinators represented only those made on the poor who desired it, but were unable to pay the modest charges demanded by private physicians. In this year and until 1882, in addition to these were included the compulsory vaccinations of those in the immediate neighborhood of known cases of small-pox. After the great campaign of compulsory vaccinations in 1882–1883, the services of the public vaccinators were available to all who might apply, and the vaccine physicians have kept special office hours for the purpose. These services of late years, especially since the system of school inspection has made it possible to compel vaccination of all school children, have been widely accepted. With the exception of special drives now and then directed against known contacts with small-pox cases, this is the only compulsion now exercised over vaccination. Since granted the power in 1882, the commissioners of health have but rarely ordered vaccination and revaccination. The State law regarding the vaccination of infants in their first year of age has been and is a dead letter.

Concerning the question of vaccinations by private physicians, it is safe to say that probably by 1814, and certainly by 1821, in the bulk of the well-to-do families in the clientele of physicians of the better type, the children were routinely vaccinated in infancy, and in many cases revaccination was practiced at puberty, and often later in life, particularly in times of small-pox epidemics, which were abundant enough until after 1884. Among such people there has probably been but little neglect in this regard, and they have passed safely through the various epidemics. Among the whites, it has been the newest immigrant who has neglected to protect himself and his family. This was particularly marked in the Irish and German immigrants, who were unaccustomed to general vaccination at home. The Bohemians, among more recent immigrants, were unfamiliar with vaccination. Among the Poles and Polish Jews vaccination was common, and the latter regularly present their children for vaccination in May. Doubtless the slave negroes were commonly vaccinated. But above all, it has been the free negro, both before and since the Civil War, who has contributed the largest quota to the army of the unvaccinated. Among these, those in domestic service have in the main accepted vaccination, partly from example and partly because employers demanded it. A third but relatively small group, composed of white persons of native birth from other States, in many other respects apparently rational, have avoided vaccination for their children and themselves on various grounds. Reports of the school inspectors showed in 1911 but 5 per cent and in 1918 less than 1 per cent of the children in the public and parochial schools had not been successfully vaccinated.

"Crusts" were much in vogue as late as 1872 and were employed to some degree until much later. Smith's virus was probably in continuous use for many years. The health department's virus, the dependence of the vaccine physicians and probably collected by them, was jealously guarded and was freely dispensed. In 1832, 1843, and 1846 it was "renewed" by passage through the cow. The

State's virus was discarded as impotent by the health department in 1872, and since that date the city health department has purchased virus from commercial firms. The large proportion of the cases of small-pox, 68 per cent, reported by the physicians in charge at the Marine Hospital as occurring in 1872 among the previously vaccinated, and with considerable but relatively low fatalities as compared with the unvaccinated, attests to previous use of virus of low potency. Prior to 1904, when the Public Health Service undertook supervision of commercial virus, much of this was perhaps either impotent or at least of poor grade. As the results were under the constant observation of the vaccine physicians, however, who would report poor virus, it was probably usually superior to the virus purchased through most druggists. Of late years the health department has dispensed in large quantities freely to physicians a pure and highly potent vaccine virus purchased by contract from commercial firms.

CHICKEN-POX.

Just when chicken-pox was first introduced into Baltimore and when it became endemic is not known. No deaths were recorded before 1821, and cases were not reported routinely until 1897. There is every reason to think that varicella has been prevalent since at least the beginning of the nineteenth century. Judging from the annual mortality rates (table 34, graph 11), it was somewhat more fatal in the earlier years than in the recent years embraced in the records, but at no time has it contributed significantly to the lists of deaths. From the morbidity reports since 1897 (table 41), it would appear that this disease has become progressively more prevalent, and it might be argued with some reason that it runs in waves of incidence like others of this group. Because of the probability of confusion in diagnosis between small-pox and chicken-pox, the almost constant presence of the former during this period has stimulated the reporting of cases of the latter when seen by physicians. However, varicella is so mild that in many cases physicians are not summoned, and to the ignorant even small-pox is not a menace. Much more likely is it that the increase in the morbidity of chicken-pox is due, in largest part at least, to more accurate reporting of cases during the past 10 years, under the pressure exercised by the health department. In this connection it may be pointed out that the morbidity-rates do not indicate that the efforts made during this period to restrict the spread of this disease have affected its course.

The monthly annual morbidity-rates (table 41) indicate very clearly the influence of season upon the prevalence of the disease. From the midsummer low point, usually August, but in some years July and in others September, the wave of incidence commonly ascends smoothly to a peak reached in January or February and declines in much the same gradual manner during the succeeding months to complete the 12-month cycle. Whether the number of cases reported is greater or smaller, the same relative distribution to season is constantly repeated. Previous to 1921, there are no data for determining the influence of race, sex, and age upon the incidence of this disease. Rates specific for these categories in this year are presented in table 42. It will be noted that of the total of 1,938 cases, 1,700 were in individuals below the tenth year of age, and that the rate in the second was double that in the first five years of life. During the first year of life, when the rates were relatively low, there

TABLE 41.—*Morbidity by months and years and the monthly annual and annual rates of morbidity, per 100,000 living inhabitants, from varicella, from 1897 to 1920, inclusive.*

C = cases. R = rate.

Year.	Jan.		Feb.		March.		April.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total.	
	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R
1897	10	24	5	13	7	17	1	3	6	15	1	3	1	2	...	...	...	...	1	2	3	8	12	29	47	10
1898	18	43	14	37	23	54	13	32	5	12	4	10	..	...	1	2	1	2	4	10	18	44	23	55	124	25
1899	13	31	17	44	9	21	12	29	8	19	11	27	3	7	4	9	3	7	7	16	32	78	64	151	183	37
1900	39	91	28	72	24	56	20	48	23	53	6	14	5	12	...	...	...	...	2	5	23	55	22	51	192	38
1901	34	78	19	48	15	34	11	26	17	39	20	47	6	14	2	5	...	...	7	16	21	50	47	108	199	39
1902	39	88	28	70	30	68	29	68	27	61	11	26	2	5	3	7	4	9	2	5	17	40	39	88	231	44
1903	50	112	18	44	26	58	9	21	20	45	10	23	3	67	6	13	9	21	11	25	33	76	61	136	256	49
1904	66	145	46	112	30	66	17	39	19	42	21	48	14	31	2	4	5	11	17	37	40	91	57	126	334	63
1905	77	168	25	60	26	57	20	45	22	48	14	32	1	2	...	...	5	11	3	7	18	41	23	50	234	43
1906	27	58	20	48	20	43	25	56	28	60	14	31	8	17	3	6	1	2	4	9	20	44	25	54	195	36
1907	43	91	39	92	41	87	26	57	31	66	4	9	13	28	2	4	1	2	9	19	34	75	63	134	306	55
1908	65	137	50	116	47	99	40	87	28	59	13	28	8	17	5	11	1	2	22	46	39	85	85	179	403	72
1909	114	237	101	233	56	116	26	56	19	40	11	24	7	15	1	2	4	9	7	15	33	71	66	137	445	79
1910	42	86	47	107	63	130	53	113	51	105	26	55	5	10	1	2	3	6	9	19	31	66	49	101	380	66
1911	66	134	60	135	51	104	25	53	43	88	20	42	4	8	3	6	11	23	17	35	65	137	130	265	495	86
1912	126	254	67	150	65	131	52	108	27	54	23	48	13	26	5	10	5	10	10	20	24	50	71	143	488	84
1913	121	241	99	219	100	200	75	155	39	78	12	25	2	4	2	4	2	4	23	46	47	97	73	146	595	101
1914	138	273	149	326	134	265	74	151	35	69	27	55	4	8	4	8	4	8	20	40	84	172	115	227	788	132
1915	157	307	108	234	107	209	51	103	42	82	27	55	18	35	11	22	16	32	29	57	63	127	135	264	764	127
1916	186	361	152	326	126	244	93	186	87	169	106	213	32	62	18	35	10	20	20	39	32	64	73	142	935	154
1917	92	177	151	321	180	346	144	286	129	248	102	203	37	71	12	23	9	18	50	96	190	378	294	565	1390	227
1918	243	463	102	215	49	93	43	85	48	92	20	39	25	48	7	13	4	8	12	23	16	32	45	86	614	99
1919	73	119	128	231	192	313	187	315	155	253	80	135	35	57	11	18	17	29	42	69	95	160	244	398	1259	175
1920	316	507	175	311	148	237	122	202	137	220	83	138	17	27	9	14	17	28	42	67	116	192	252	404	1434	195

was no significant difference in morbidity among whites and negroes, and in respect of the two sexes the difference was not great. However, the highest rates occurred in white males and the lowest in white females. From 1 to 4

TABLE 42.—*Number of cases and rate of morbidity, per 100,000 living inhabitants in 1920, for chicken-pox and mumps, according to age, color, and sex, for 1921.*

C = cases. R = rate.

Age-groups.	Chicken-pox.													
	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	C	R	C	R	C	R	C	R	C	R	C	R	C	R
Under 1 year	98	660	85	660	51	773	34	541	13	661	6	627	7	692
1 to 4 years	484	888	426	886	220	911	206	860	58	905	20	642	38	1154
0 to 4 years	582	839	511	838	271	881	240	554	71	848	26	639	45	1045
5 to 9 years	1118	1734	1053	1866	540	1889	513	1843	65	806	42	1088	23	547
0 to 9 years	1700	1270	1564	1332	811	1367	753	1297	136	827	68	857	68	799
10 to 19 years	186	150	165	153	75	142	90	164	21	132	9	127	12	135
20 to 29 years	30	21	19	16	13	22	6	10	11	43	6	49	5	37
30 to 39 years	16	13	11	11	6	12	5	10	5	23	5	45	...	....
40 to 49 years	5	5	3	4	2	5	1	3	2	13	1	12	1	14
50 to 59 years	....	....	....	....	...	....	...	....	...	...	...	....	...	....
60 to 69 years	1	3	1	3	1	7	...	....	...	...	...	....	...	....
70 to 79 years	....	....	....	....	...	....	...	....	...	...	...	....	...	....
80 years and over	....	....	....	....	...	....	...	....	...	...	...	....	...	....
Total ..	1938	264	1763	282	908	294	855	270	175	161	89	167	86	155

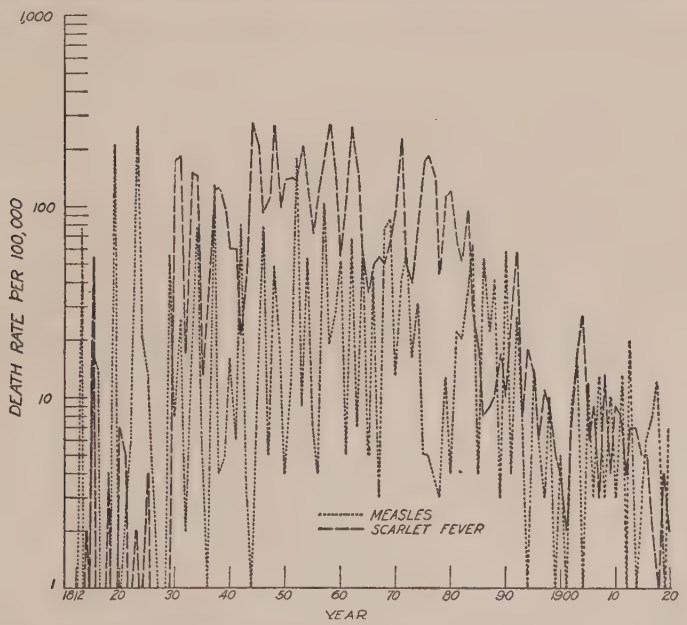
Age-groups.	Mumps.													
	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	C	R	C	R	C	R	C	R	C	R	C	R	C	R
Under 1 year.....	2	13	2	16	2	30	...	...	...	...	...	...	...	...
1 to 4 years.....	97	178	79	164	49	203	30	125	18	281	11	353	7	213
0 to 4 years.....	99	143	81	133	51	166	30	69	18	215	11	270	7	163
5 to 9 years.....	476	738	438	776	262	917	176	632	38	471	20	518	18	428
0 to 9 years.....	575	430	519	442	313	528	206	355	56	341	31	391	25	294
10 to 19 years.....	175	141	128	119	69	131	59	107	47	295	22	311	25	281
20 to 29 years.....	38	26	29	24	16	27	13	22	9	35	5	41	4	29
30 to 39 years.....	19	16	17	17	10	20	7	14	2	9	...	...	2	19
40 to 49 years.....	1	1	1	1	1	3	...	...	...	...	...	...	...	...
50 to 59 years.....	2	3	2	4	...	...	2	7	...	...	...	...	...	...
60 to 69 years.....	1	3	1	3	...	...	1	6	...	...	...	...	...	...
70 to 79 years.....	1	7	1	8	...	...	1	13	...	...	...	...	...	...
80 years and over....	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	812	111	698	112	409	133	289	91	114	105	58	109	56	101

years, with rates somewhat higher for negroes than for whites, the incidence was again higher in whites among males and in negroes among females. The consequence is that for the age period 0 to 4 years morbidity was practically

the same for whites and negroes, among whites considerably higher for males than for females, and among negroes for females than for males. In the age-group 5 to 9 years, morbidity among whites was more than double that among negroes, on about the same level for the two sexes in whites, but twice as great for males as for females in negroes. As a net result in the first decade of life, in which the overwhelming majority of the cases occurred, the rate of incidence was greater in whites than in negroes by about one-fourth and somewhat greater in males than in females of both races.

SCARLET FEVER.

The annals of Baltimore do not mention the occurrence of scarlet fever in the eighteenth century, and, if it appeared at all, it was probably in a form so



GRAPH 13 (from table 34). Annual crude mortality-rates from scarlet fever and measles, from 1812 to 1920, inclusive.

mild that few or no deaths were attributable to it. However, as in those times, and indeed until well after the middle of the nineteenth century, it was included among that group of diseases generally regarded as necessary afflictions of the human race, inevitable, uncontrollable, and, therefore, except when present in the form of severe epidemic visitation, it would not, unless by chance, have found space in local chronicles. That the disease was imported repeatedly from Europe and passed at quarantine there is no doubt. As late as 1895, cases were often sent in large numbers from immigrant ships to the University of Maryland and other hospitals, where provisions for isolation were primitive in the extreme. It is probable that, between 1830 and 1900, due to classification under dropsy, nephritis, middle-ear disease, meningitis, and even diphtheria, and the rubrics for other complications, the number of deaths from scarlet fever was actually larger than officially recorded. The course of the curve for the annual mortality for the whole period (table 34, graph 13) is marked by wide fluctua-

tions, which are in general of two general types. Fluctuations of the first type depend upon differences in the general level of the rates over comparatively long series of years and represent true waves of high or low mortality. Three such waves stand out with distinctness.

The first wave, characterized by very low mortality, covers approximately the second and third decades of the nineteenth century, when, in fatal form at least, scarlet fever was rare in Baltimore. Between 1811 and 1829 there were but 13 recorded deaths. The first was in 1814, and then after an interval of 5 years there were 4 in 1820 and 3 in 1821. With 1 death in 1823, and 3 in 1825, 4 years elapsed before the single fatality in 1829. As judged by recorded fatalities during this period, scarlet fever occurred only sporadically; if endemically established the disease was extremely mild. Quite different was its course after 1829. Since this date, in every year scarlet fever has been credited with deaths, and probably at no time has the city been entirely free from cases.

After the sudden outbreak in 1830, with a death rate of 172, the disease entered on a long wave of high mortality, which, though broken here and there by recessions, lasted until 1885. In many of these 55 years the disease was a veritable scourge. Years of exceptionally high fatality were 1844, 1845, 1853, 1858, 1862, and 1871, when the rates were 270, 204, 263, 203, 263, 255, and 224, respectively. As late as 1875 and 1876 the rates were as high as in 1830 and 1831. After 1880 the rate did not surpass 100.

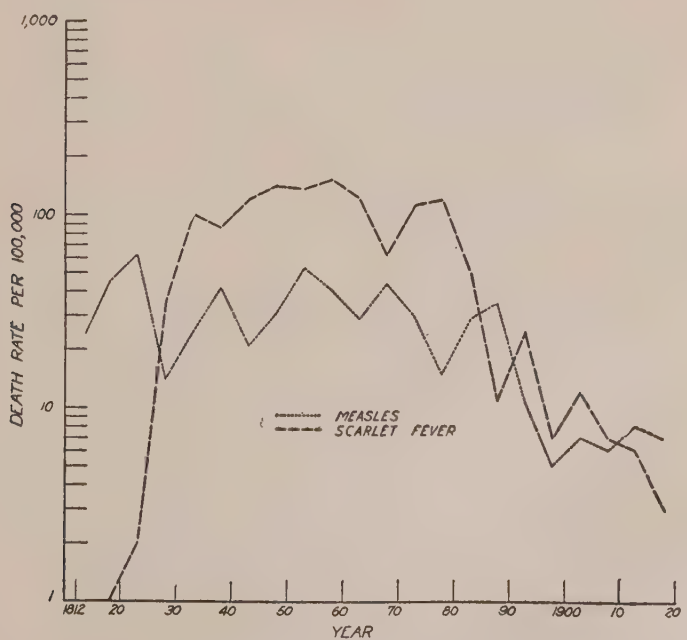
The third wave, which embraces the period since 1885, is characterized by lower and gradually declining rates. During this time the highest rates attained were 57 in 1892, 29 in 1891, and 27 in 1904. Rates as low as 2 were recorded in 1901, 1917, and 1920, and in 1918 the rate was 1. Since 1905, scarlet fever in Baltimore has almost lost its lethal force, which now exhibits a strong tendency to decline to the level obtaining previous to 1830.

The second type of fluctuation in the annual rates is dependent upon a quite different characteristic, namely, the frequent occurrence of minor epidemic waves extending over 2 or 3 years and followed by from one to several years of remission, or, even in some periods, of complete intermission. These minor waves recur constantly, though not always at equal intervals, whether the general level of mortality be low or high, and evidently reflect inherent characters of the disease.

A much clearer picture of the course of scarlet fever is given by the curve of the mortality-rates as averaged for 5-year periods (table 43, graph 14). With rates of 1 for the periods ending in 1815 and 1820 and of 2 for that ending in 1825, the rates for the period ending in 1830 jumped to 35, owing to the sudden outbreak of the disease in this year. From 1835, the curve of the averaged rates, except for slight recessions in 1836–1840 and 1851–1855, rose steadily to 151 in 1856–1860. This represents the peak of the mortality of this disease. Falling during the next 10 years the averaged rate was 62 in 1866–1870. Reacting from this, the rates moved upward during 10 years to 119 in 1876–1880. This was followed by a fall in the rates to 50 in 1881–1885 and to 11 in 1886–1890. From this low level there was a reaction to 25 in 1891–1895, but by 1896–1900 the rate had fallen to 7. For the succeeding 5 years this rate rose to 12, only to fall to 7 in 1906–1910, 6 in 1911–1915, and 3 in 1916–1920.

TABLE 43.—*Average rate of death by 5- and 10-year periods from total acute exanthematous diseases, from 1812 to 1920, inclusive.*

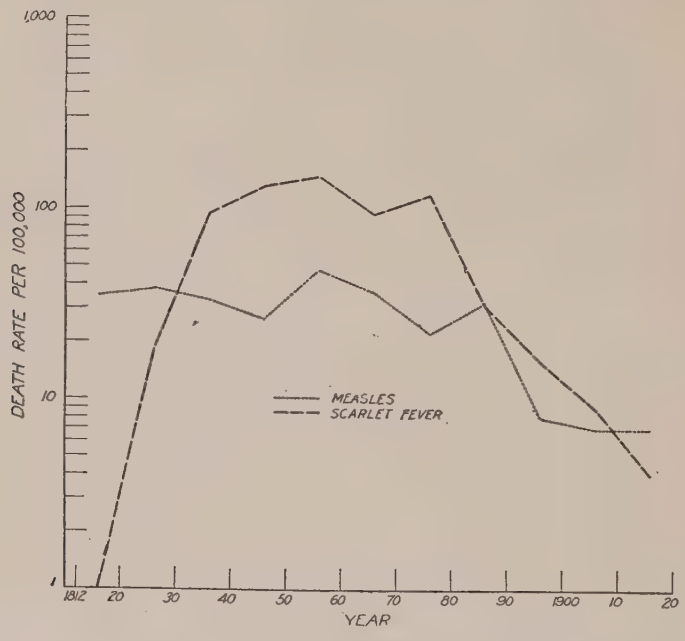
Periods.	Small-pox.		Varicella.		Scarlet fever.		Measles.		Influenza.		Total acute exanthematous diseases.	
	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.
1812-15	46	...	...	...	1	...	24	...	13	...	83	...
1816-20	2	21	...	...	1	1	45	35	1	6	48	64
1821-25	48	...	...	...	2	...	62	...	...	...	132	...
1826-30	4	26	...	...	35	18	14	38	...	...	53	83
1831-35	44	...	...	...	101	...	25	...	32	...	202	...
1836-40	25	35	2	1	86	93	42	33	...	16	154	178
1841-45	16	...	...	...	119	...	21	...	1	...	157	...
1846-50	38	27	1	...	140	129	31	26	1	1	210	183
1851-55	29	...	1	...	135	...	53	...	...	...	218	...
1856-60	41	35	1	1	151	143	41	47	...	...	233	225
1861-65	63	...	1	...	122	...	29	...	...	...	215	...
1866-70	1	32	...	1	62	92	44	36	...	...	107	161
1871-75	105	...	1	...	112	...	30	...	...	...	248	...
1876-80	...	53	...	...	119	116	15	22	...	...	133	191
1881-85	67	...	...	...	50	...	29	...	...	...	147	...
1886-90	...	34	...	...	11	31	35	32	1	...	47	97
1891-95	...	...	...	...	25	...	11	...	36	...	72	...
1896-1900	...	...	...	...	7	16	5	8	21	29	33	53
1901-05	...	...	...	...	12	...	7	...	17	...	37	...
1906-10	...	...	...	...	7	9	6	7	17	17	31	34
1911-15	...	...	...	...	6	...	8	...	13	...	27	...
1916-20	...	...	...	...	3	4	7	7	84	48	94	60



GRAPH 14 (from table 43). Crude mortality-rates from scarlet fever and measles, averaged by 5-year periods, from 1812 to 1920, inclusive

Owing to the very great variation in the annual mortality rates, the rates as averaged for 10-years periods (table 43, graph 15) give perhaps an even more correct picture of the course of the lethal force of this disease. As a result of the greater smoothing, the progress of the curve of the rates is unbrokenly upward to 1851–1860, with a rate of 143, and from this point, but for a slight reaction in 1871–1880, the course of the curve is continuously downward. The rates for the last four decennia were 31, 16, 9, and 4.

From this analysis it is clear that the lethal force of scarlet fever, negligible before 1830, gained continuously in vigor for three decades and reached its zenith in that ending in 1860, and since this date it has gradually and almost



GRAPH 15 (from table 43). Crude mortality-rates from scarlet fever and measles, averaged by 10-year periods, from 1812 to 1920, inclusive.

uninterruptedly lost in strength, so that 40 years later (1900) it had returned to the level of 1830. By 1920 the force of mortality had fallen almost to the level of 1820. In this century scarlet fever, considered as a cause of mortality, had risen gradually from a position of no importance to become for many years a scourge and had fallen as gradually back to its primary position.

As at least 90 per cent of all deaths from scarlet fever occur in individuals under 10 years of age and 70 per cent in those under 5 years, any considerable changes in the proportional relations of these age-groups to the whole population must have exerted an important influence upon the course of its mortality. Between 1850 and 1920, the proportions in the population of individuals in age-group 0 to 4 years declined by 34 per cent, in age-group 5 to 9 years by 26 per cent, and in age group 0 to 9 years by 31 per cent, and it may be held that the decline in the scarlet-fever death-rate during this period was

influenced in something like these ratios solely by shrinkage in these proportions in the relative numbers of individuals of susceptible age. In table 44 are given the rates for scarlet fever for the census years from 1830 to 1920, inclusive, calculated on the basis of the populations under 10 years of age. These rates, within somewhat broad limits, specific for age for these particular years, demark the course of this disease with much greater precision than do the crude

TABLE 44.—*Number of deaths and rate of death, per 100,000 living inhabitants under 10 years of age, from scarlet fever and measles, for the decennia 1830 to 1920, inclusive.*

D = death. R = rate.

Year.	Scarlet fever.		Measles.		Year.	Scarlet fever.		Measles.	
	D	R	D	R		D	R	D	R
1830.....	103	495	25	120	1880.....	327	440	43	58
1840.....	85	318	32	120	1890.....	80	87	92	101
1850.....	204	457	20	45	1900.....	18	18	11	11
1860.....	223	397	59	105	1910.....	39	38	50	49
1870.....	350	537	124	190	1920.....	14	10	18	13

* The number of deaths for each decennium is a 3-year average of that obtaining in the decennial year and in those years immediately preceding and following, except in 1920 when the average is for 1919 and 1920 only.

rates already considered. It is obvious that the picture is somewhat distorted, for had the calculations been extended to include every year, rates much higher and much lower than those obtained would have been found.

Frick's analysis of the deaths from scarlet fever in Baltimore in 1850 showed rates per 10,000 inhabitants of 13.8 for whites and 10.8 for blacks; the lesser mortality among the blacks he thought was probably due to the greater difficulty in diagnosis of the disease in this race. Classified according to sex, 49 per cent of the deaths were in males and 51 per cent were in females. The proportion of the 225 deaths he ascribed to the different ages is shown in table 45.

TABLE 45.

	p. c.
Under 1 year	10.9
Between 1 and 2 years	25.1
Between 2 and 3 years	20.0
Between 3 and 4 years	10.9
Between 4 and 5 years	9.1
Between 5 and 10 years	20.0
Between 10 and 20 years	9.7
Over 20 years	0.3

The death-rates specific for age are given in table 36 (p. 284).

In one of the few allusions in the annual reports to the specific qualities of scarlet fever, the commissioner of health, in 1870, in the midst of the period of its greatest fatality, remarked that it attacked persons of all ages, but confined its ravages principally to children between 3 and 9 years, and that few diseases were so prevalent among children and none more fatal.

Of the 488 deaths recorded from scarlet fever during the 15-year period 1905–1919, 457 were in whites, with 227 in males and 230 in females, and 31 were in negroes, with 15 in males and 16 in females (table 46). While there are no significant differences in the mortality between males and females

TABLE 46.—*Number of deaths and rate of death, per 100,000 living inhabitants, from scarlet fever and measles, according to color and sex, from 1905 to 1919, inclusive.*

SCARLET FEVER.

D = death. R = rate.

Year.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1905	32	6	29	6	18	8	11	5	3	4	2	5	1	2
1906	43	8	41	9	13	6	28	12	2	2	1	3	1	2
1907	14	3	14	3	7	3	7	3	...	...	...	...	...	...
1908	70	13	66	14	29	13	37	15	4	5	2	5	2	4
1909	22	4	22	5	13	6	9	4	...	...	...	...	...	...
1910	49	9	47	10	24	10	23	9	2	2	1	2	1	2
1911	44	8	41	8	21	9	20	8	3	3	1	2	2	4
1912	23	4	22	4	9	4	13	5	1	1	...	...	1	2
1913	45	8	42	8	24	10	18	7	3	3	1	2	2	4
1914	35	6	28	6	14	6	14	6	7	7	3	7	4	8
1915	32	5	29	6	18	7	11	4	3	3	1	2	2	4
1916	30	5	30	6	13	5	17	7	...	...	...	...	...	...
1917	11	2	11	2	6	2	5	2	...	...	...	...	...	...
1918	8	1	6	1	4	2	2	1	2	2	2	4	...	...
1919	30	4	29	5	14	5	15	5	1	1	1	2	...	...

MEASLES.

1905	84	16	65	14	33	7	32	14	19	23	8	21	11	24
1906	10	2	8	2	3	1	5	2	2	2	1	3	1	2
1907	67	12	49	10	23	10	26	11	18	21	5	13	13	27
1908	17	3	15	3	8	3	7	3	2	2	2	5	...	...
1909	51	9	37	7	23	10	14	6	14	16	8	20	6	12
1910	17	3	16	3	11	5	5	2	1	1	...	...	1	2
1911	73	13	60	12	32	13	28	11	13	14	8	19	5	10
1912	5	1	5	1	2	1	3	1	...	...	...	...	...	...
1913	115	19	86	17	50	20	36	14	29	31	20	47	9	18
1914	5	1	5	1	1	...	4	2	...	...	...	...	...	...
1915	17	3	13	3	5	2	8	3	4	4	2	5	2	4
1916	34	6	29	6	17	7	12	5	5	5	3	7	2	4
1917	51	8	40	8	20	8	20	8	11	11	6	13	5	9
1918	75	12	62	12	29	11	33	13	13	13	4	9	9	17
1919	7	1	7	1	6	2	1	...	...	...	...	...	...	...

among either whites or blacks, the fatality was proportionally nearly three times greater in the white than in the negro race, the number of deaths standing in the ratio of 15 to 1, and the population 5.42 to 1, repectively, a remarkably high shift in favor of the negro since 1850. It is unlikely that such a great difference is to be explained entirely by greater difficulty in diagnosis in the negro.

The results of calculations to determine the influence of age, sex, and color upon the mortality of scarlet fever in 1910 and 1920 are shown in tables 47 and 48. Whereas there are no significant differences between the rates for all ages in males and females of the white and colored races, the total white rate is over four times as great as that for negroes. Owing to the smallness of the number of deaths and the differences in the age-groupings, direct comparison

TABLE 47.—*Number of deaths and rate of death, per 100,000 living inhabitants, from scarlet fever and measles, according to age, color, and sex, for 1910.*

SCARLET FEVER.

D = death. R = rate.

Age period.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
Under 1 year	1	10	1	11	1	22	...	...	...	...	...	...	...	...
Between 1 and 2 years	7	73	7	83	3	68	4	98	...	...	...	...	...	...
2 to 4 years	23	72	22	79	13	92	9	65	1	24	1	50	...	...
5 to 9 years	10	20	10	23	7	32	3	14	...	...	...	...	...	...
Under 10 years	41	40	40	45	24	54	16	36	1	8	1	16	...	...
10 to 19 years	5	5	4	4	...	...	4	9	1	7	...	...	1	13
20 to 29 years	1	1	1	1	...	...	1	2	...	...	...	...	...	...
30 to 39 years	1	1	1	1	...	...	1	3	...	...	...	...	...	...
40 to 49 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
50 to 59 years	1	2	1	3	...	...	1	5	...	...	...	...	...	...
60 years and over	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	49	9	47	10	24	10	23	9	2	2	1	3	1	2

MEASLES.

Under 1 year	3	29	3	34	1	22	2	45	...	...	...	...	...	...
Between 1 and 2 years	12	125	11	130	8	182	3	73	1	89	...	...	1	175
2 to 4 years	1	31	1	4	1	7	...	...	...	...	...	...	...	...
5 to 9 years	1	2	1	2	1	5	...	...	...	...	...	...	...	...
Under 10 years	17	17	16	18	11	25	5	11	1	8	...	...	1	15
10 to 19 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
20 to 29 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
30 to 39 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
40 to 49 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
50 to 59 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
60 years and over	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	17	3	16	3	11	5	5	2	1	1	...	...	1	2

of the relative influence of age in this year and in 1850, as shown in the rates described from Frick's figures, is difficult. In both tables the great bulk of the deaths occur under the tenth year.

Though legally reportable since 1882, there are no records of reported cases of scarlet fever before 1893, and it is only since 1897 that case reporting has approached accuracy. The absolute figures of reported cases by months and years and the appropriate rates are presented in table 49. These monthly

annual and the annual morbidity-rates from 1897 to 1920 may be compared with similar rates for mortality given in table 50. The course of the curves for the morbidity- and mortality-rates during this period corresponds very closely. Such differences as exist are not very significant and are, in large part at least, explained by the lag of deaths behind reported cases. The degree of difference, that is, the variation in the relative heights of the two curves in

TABLE 48.—*Number of deaths and rate of death, per 100,000 living inhabitants, from scarlet fever and measles, according to age, color, and sex, for 1920.*

SCARLET FEVER.

D = death. R = rate.

Age-groups.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R		R	D	R	D	R	D	R
Under 1 year	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1 to 4 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
0 to 4 years	8	12	8	13	4	13	4	9	...	...	...	...	...	...
5 to 9 years	1	2	1	2	1	3	...	...	...	...	...	...	...	...
0 to 9 years	9	7	9	8	5	8	4	7	...	...	...	...	...	...
10 to 19 years	1	1	1	1	...	...	1	2	...	...	...	...	...	...
20 to 29 years	2	1	2	2	...	...	2	3	...	...	...	...	...	...
30 to 39 years	1	1	1	1	1	2	...	...	...	...	...	...	...	...
40 to 49 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
50 to 59 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
60 to 69 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
70 to 79 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
80 years and over	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	13	2	13	2	6	2	7	2	...	...	...	...	...	...

MEASLES.

Under 1 year	12	81	10	78	6	91	4	64	2	101	1	104	1	99
1 to 4 years	34	62	30	62	17	70	13	54	4	62	2	64	2	61
0 to 4 years	46	66	40	66	23	75	17	39	6	72	3	74	3	70
5 to 9 years	3	5	3	5	2	7	1	4	...	...	...	...	...	...
0 to 9 years	49	37	43	37	25	42	18	31	6	36	3	38	3	35
10 to 19 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
20 to 29 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
30 to 39 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
40 to 49 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
50 to 59 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
60 to 69 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
70 to 79 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
80 years and over	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	49	7	43	7	25	8	18	6	6	6	3	6	3	5

corresponding years, is often marked, and reflects the considerable variation in the annual case-fatality rates.

Referring to table 49, it will be noted that, beginning in 1897 with a rate of 212 the morbidity-rates declined during the succeeding 4 years to 76 in 1901. Rising then to 92 in 1902 and abruptly to 232 in 1903 and 229 in 1904, they

TABLE 49.—*Morbidity by months and years and the monthly annual and annual rates of morbidity, per 100,000 living inhabitants, from scarlet fever, from 1897 to 1920, inclusive.*

C = cases. R = rate.

Year.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total.			Percentage case fatality.	
	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	Cases.	Rate.	Average rate of morbidity by 5yr. periods.	Annual.	Average by 5-year periods.
1897	119	288	83	223	117	284	102	255	101	245	89	223	59	143	58	141	60	150	59	143	80	200	101	245	1028	212	.....	5	.....
1898	99	236	63	167	69	165	41	101	49	117	49	121	31	74	33	79	33	81	50	119	33	81	38	91	588	119	.....	8	.....
1899	38	89	34	89	56	132	36	88	42	99	22	54	11	26	15	35	33	80	55	129	35	85	57	134	434	87	.....	6	.....
1900	48	111	26	67	40	93	21	50	20	46	13	31	20	46	17	39	33	79	47	109	69	166	48	111	402	79	124	5	6
1901	62	142	32	81	50	115	38	90	42	96	36	85	9	21	16	37	18	43	23	53	29	69	36	82	391	76	.....	3	.....
1902	28	63	45	113	36	81	32	75	49	111	45	105	40	90	29	66	49	114	56	127	45	105	27	61	481	92	.....	8	.....
1903	55	123	38	94	59	132	93	215	139	310	103	238	115	257	122	272	140	323	106	237	131	302	123	275	1224	232	.....	7	.....
1904	136	300	99	242	125	276	151	344	192	423	101	230	63	139	43	95	80	182	72	159	52	118	108	238	1222	229	.....	12	.....
1905	98	213	54	130	77	168	50	113	47	102	45	101	32	70	20	44	41	92	40	87	55	124	56	122	615	114	149	5	7
1906	76	164	43	102	50	108	49	109	63	136	35	78	31	67	44	95	55	122	49	105	46	102	36	77	577	105	.....	8	.....
1907	28	60	25	59	36	77	19	42	36	77	19	42	20	43	15	32	11	24	47	100	55	121	125	266	436	79	.....	3	.....
1908	144	303	191	445	234	492	142	309	167	351	77	167	74	156	66	139	49	106	84	177	81	176	53	111	1362	243	.....	5	.....
1909	45	94	48	111	44	92	37	80	35	73	17	37	23	48	39	81	25	54	28	58	41	88	74	154	456	81	.....	5	.....
1910	95	195	114	260	140	288	165	351	162	333	111	236	51	105	44	91	21	45	68	140	94	200	108	222	1173	205	143	4	5
1911	127	259	113	255	133	271	113	238	83	169	72	151	42	86	41	83	64	135	104	212	106	223	120	244	1118	193	.....	4	.....
1912	105	212	86	192	93	187	45	94	59	119	48	100	25	50	32	64	25	52	49	99	75	156	108	218	750	128	.....	3	.....
1913	112	223	119	263	121	241	122	252	118	235	89	184	54	108	58	116	63	130	79	158	105	217	98	196	1138	193	.....	4	.....
1914	79	156	79	173	115	227	93	190	69	136	80	163	42	83	31	61	17	35	30	59	54	110	113	223	802	135	.....	5	.....
1915	181	354	155	336	130	255	152	308	111	217	70	142	51	100	28	55	58	117	90	176	123	249	121	237	1270	211	172	3	4
1916	190	369	111	238	168	326	126	253	115	223	67	134	45	87	19	37	28	56	19	37	31	62	47	91	966	159	.....	3	.....
1917	50	96	33	70	49	94	74	147	70	135	42	83	19	37	12	23	25	50	39	75	65	129	64	123	542	89	.....	2	.....
1918	50	95	46	97	36	69	35	69	39	74	23	45	17	32	6	11	20	39	27	51	22	43	45	86	366	59	.....	2	.....
1919	160	261	501	906	808	1319	913	1540	700	1143	240	405	58	95	48	78	44	74	98	160	116	196	174	284	3860	535	.....	1	.....
1920	211	339	238	423	190	305	139	230	99	159	74	123	24	39	36	58	34	56	67	108	51	85	85	136	1248	170	202	1	2

TABLE 50.—*Number of deaths by months and years, and the monthly annual and annual rates of death, per 100,000 living inhabitants, scarlet fever, from 1856 to 1920, inclusive.*

D = death. R = rate.

Year.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1856	17	104	7	47	20	122	20	126	22	134	18	113	14	85	10	61	21	132	18	110	19	120	36	219	222	115
1857	57	338	67	440	52	308	32	196	24	148	16	98	20	119	7	42	9	55	17	101	26	159	26	154	353	178
1858	33	191	38	243	73	422	31	185	38	220	20	119	23	133	48	277	49	293	70	404	55	328	57	329	535	263
1859	62	349	47	293	47	265	34	198	25	141	11	64	13	73	22	124	9	52	11	62	7	41	13	73	301	144
1860	13	71	13	79	10	55	16	91	5	27	5	28	7	38	3	16	3	17	12	66	12	68	17	93	116	54
1861	15	80	10	59	5	27	17	94	8	43	12	66	9	48	11	59	27	150	28	150	30	166	80	428	252	115
1862	67	350	62	358	59	308	58	313	53	277	52	281	56	292	32	167	27	146	35	183	37	200	37	193	575	255
1863	49	250	48	271	51	260	28	137	28	143	38	190	23	117	13	66	15	68	6	31	21	100	19	97	339	147
1864	16	80	25	138	16	80	18	92	18	89	10	51	6	30	2	10	2	10	4	20	7	36	12	60	136	57
1865	17	83	7	38	7	34	3	15	7	34	3	15	3	15	5	24	6	30	7	34	11	55	10	49	86	35
1866	15	71	6	31	2	9	8	39	4	19	11	54	15	71	15	71	4	20	12	57	9	44	20	95	121	49
1867	14	65	18	92	27	125	19	91	12	56	9	43	10	46	3	14	4	19	7	32	8	38	6	28	137	54
1868	5	23	2	10	1	5	9	42	8	36	9	42	2	9	8	36	14	65	19	86	25	117	25	113	127	49
1869	16	71	19	93	14	62	8	37	18	80	9	41	10	44	10	44	12	55	7	31	26	119	22	97	171	64
1870	29	125	15	72	19	82	21	94	13	56	12	54	18	78	18	78	11	49	15	65	34	152	51	220	256	94
1871	110	464	83	388	65	274	73	318	99	418	55	240	55	232	27	114	16	70	15	63	12	52	15	63	625	224
1872	18	74	13	59	11	45	10	43	13	54	3	13	3	12	7	29	19	81	12	50	13	55	19	78	141	49
1873	7	28	5	22	12	48	12	50	15	61	10	42	9	36	5	20	5	21	4	16	7	29	24	97	115	39
1874	16	63	15	66	15	59	11	45	15	59	17	69	9	36	14	55	15	61	16	63	38	155	53	209	234	78
1875	59	228	60	257	48	186	48	192	43	166	47	188	43	166	29	112	33	132	29	112	33	132	47	182	519	170
1876	68	257	69	289	79	299	45	176	31	117	23	90	21	79	31	117	19	74	26	98	48	188	102	386	562	181
1877	77	285	61	250	72	267	46	176	37	137	47	180	26	96	22	81	13	50	12	44	19	73	15	56	447	141
1878	11	40	6	24	8	29	5	19	7	25	14	52	11	40	19	69	9	34	16	58	15	56	20	73	141	43
1879	12	43	18	71	27	96	21	77	32	114	27	99	34	121	35	124	32	117	33	117	47	172	49	174	367	111
1880	44	153	31	119	22	77	28	101	31	108	29	104	36	125	31	108	24	86	52	181	33	119	39	136	400	118
1881	58	198	34	129	20	68	21	74	14	48	15	53	7	24	8	27	6	21	12	41	8	28	12	41	215	62
1882	12	40	12	44	15	50	31	107	18	60	18	62	9	30	14	47	8	28	12	40	10	35	20	67	179	51
1883	28	92	37	134	37	121	28	95	39	128	37	125	19	62	22	72	37	125	13	43	22	74	15	49	334	96
1884	13	42	9	32	16	51	5	17	16	51	16	53	5	16	7	22	3	10	3	10	5	17	6	19	104	28

1885	11	35	6	21	8	25	9	29	9	28	6	20	5	16	6	19	1	3	...	...	3	10	4	13	68	18
1886	7	22	2	7	3	9	2	6	7	22	1	3	1	3	3	9	2	6	...	...	3	10	1	3	32	8
1887	5	15	2	7	6	18	2	6	1	3	6	19	3	9	1	3	3	9	4	12	3	9	...	...	36	9
1888	8	22	3	9	3	8	3	9	2	6	2	6	5	14	...	...	2	6	6	17	3	9	7	20	44	10
1889	4	11	...	...	15	41	5	14	6	17	12	34	8	22	5	14	2	6	5	14	7	20	2	6	71	17
1890	2	5	2	6	5	14	5	14	5	14	4	11	7	19	...	...	...	...	3	8	5	14	4	11	42	10
1891	4	11	1	3	4	11	8	22	3	8	9	25	8	21	6	16	11	30	15	40	20	55	39	104	128	29
1892	50	131	58	168	57	149	45	122	23	60	5	14	2	5	2	5	1	3	6	16	4	11	5	13	258	57
1893	1	3	...	...	...	...	...	...	3	8	1	3	4	10	1	3	2	5	1	3	12	32	11	28	36	8
1894	7	18	14	39	12	30	3	8	6	15	5	13	10	25	5	13	4	10	11	28	3	8	5	13	85	18
1895	9	22	9	25	6	15	7	18	4	10	5	13	4	10	2	5	3	8	3	7	1	3	6	15	59	13
1896	2	5	2	5	3	7	3	8	4	10	3	8	3	7	...	...	1	3	4	10	1	3	5	12	31	6
1897	5	12	6	16	7	17	6	15	7	17	2	5	4	10	4	10	3	8	3	7	3	8	3	7	53	11
1898	2	5	7	19	5	12	9	22	8	19	8	20	2	5	2	5	2	5	1	2	...	...	...	...	46	9
1899	...	...	7	18	1	2	3	7	3	7	2	5	3	7	1	2	...	...	1	2	2	5	1	2	24	5
1900	1	2	3	8	4	9	1	2	...	...	1	2	...	...	2	5	3	7	...	...	2	5	3	7	20	4
1901	2	5	1	3	...	...	...	...	1	2	...	...	1	2	...	...	...	...	3	7	2	5	1	2	11	2
1902	3	7	5	13	1	2	...	...	5	11	4	9	5	11	3	7	2	5	2	5	6	14	1	2	37	7
1903	2	4	1	2	4	9	6	14	11	25	6	14	11	25	11	25	8	18	9	20	6	14	9	20	84	16
1904	3	7	7	17	10	22	20	46	28	62	16	36	9	20	9	20	15	34	6	13	8	18	12	26	143	27
1905	9	20	4	10	4	9	5	11	...	...	3	7	...	...	...	...	...	...	2	4	...	...	6	13	33	6
1906	2	4	3	7	4	9	5	11	7	15	6	13	5	11	5	11	5	11	2	4	1	2	2	4	47	9
1907	2	4	1	2	2	4	...	...	2	4	1	2	...	...	...	...	1	2	2	4	2	4	2	4	15	3
1908	7	15	9	21	11	23	8	17	13	27	6	13	7	15	2	4	2	4	3	6	2	4	...	...	70	13
1909	2	4	2	5	3	6	...	...	1	2	1	2	4	8	...	...	3	6	3	6	1	2	5	10	25	4
1910	6	12	6	14	7	14	7	15	6	12	2	4	3	6	2	4	1	2	...	...	3	6	6	12	49	9
1911	6	12	7	16	8	16	4	8	6	12	3	6	...	...	...	...	3	6	1	2	2	4	4	8	44	8
1912	5	10	2	4	5	10	1	2	2	4	1	2	...	...	2	4	1	2	...	...	2	4	2	4	23	4
1913	4	8	6	13	4	8	7	14	4	8	2	4	3	6	1	2	3	6	1	2	1	2	4	8	40	7
1914	4	8	5	11	12	24	2	4	1	2	3	6	1	2	3	6	3	6	2	4	2	4	1	2	39	7
1915	2	4	1	2	2	4	2	4	6	12	4	8	3	6	...	...	2	4	5	10	4	8	2	4	33	5
1916	4	8	6	13	7	14	2	4	8	16	...	...	2	4	...	...	...	...	1	2	...	...	...	...	30	5
1917	...	...	1	2	1	2	1	2	2	4	2	4	...	...	1	2	...	...	1	2	...	...	2	4	11	2
1918	...	...	...	...	2	4	...	...	1	2	2	4	...	...	...	...	...	...	2	4	...	...	1	2	8	1
1919	2	3	3	5	9	15	7	12	5	8	3	5	...	...	...	...	1	2	...	...	...	...	...	...	30	4
1920	2	3	2	4	3	5	1	2	...	...	1	2	1	2	1	2	...	...	1	2	...	...	1	2	13	2

fell by gradual stages to 79 in 1907. Rebounding sharply to 243 in 1908, the course heretofore pursued was abandoned, and the rate dropped abruptly to 81 in 1909. The course of the disease, as judged by its behavior in calendar years, was modified again, when the rate rose to 205 in 1910, and fell the next year to 193, and in 1912 to 128. After rising to 193 in 1913, and falling to 135 in 1914, the rate ascended to 211 in 1915. Again there was a change in the course of the disease. Instead of ascending and declining in alternate years, as had been the habit since 1912, the rate now dropped abruptly for three successive years, and in 1918 reached the unusually low level of 59, the lowest recorded morbidity incidence. In 1919, with a suddenly renewed vigor of attack, the rate rose to the remarkably high level of 535. The considerable drop in 1920 to 170 left the rate appreciably higher than the average.

When the course of morbidity during these 24 years is measured by rates averaged for 5-year periods, it is seen (table 49) that from the comparatively low level of 124 for 1897–1900 (4 years) it increased to 149 for 1901–1905, remained stationary at 143 for 1906–1910, and rose considerably to 172 for 1911–1915 and to 212 for 1916–1920. During this period the mortality-rates averaged for the same periods pursued quite a different course. Rising out of all proportion to the rise in the morbidity-rates from 7 for the first period to 12 for the second, they fell to 7 for the third period, when the morbidity-rates were stationary, and during the remaining periods declined continuously to 3 in 1920, in the face of constantly rising morbidity-rates. The case fatality rates similarly averaged fell from 6 per cent to 2 per cent. Thus the striking spectacle is presented of a rise in the incidence of attack by 58 per cent and declines in the death-rate by 57 per cent and in the case-fatality rate by 67 per cent.

For the sake of comparison it will be profitable to form some approximate estimate of what, on the basis of recent case-fatality experience, the morbidity would have been when the mortality was much higher. For this purpose, as examples of the highest and lowest average case-fatality rates of recent experience, those of 1901–1905, 7 per cent, and those of 1916–1920, 2 per cent, will be taken. As sample years with high death-rates, 1850 and 1871, when the deaths numbered 225 and 625, and the population numbered 163,930 and 278,932, respectively, will serve. On this basis, in 1850 the higher case incidence would have been 11,250, or a morbidity-rate of 6,863, and the lower 3,214, or a morbidity-rate of 1,961; in 1871, the higher case incidence would have been 31,250 with a morbidity-rate of 11,203, and the lower, 8,929, or a morbidity-rate of 3,201. The mortality-rates were 137 in 1850 and 224 in 1871. Expressed otherwise, calculated on the basis of the population under 10 years of age, in 1850 the higher case incidence would have equaled 1 in every 4 and the lower 1 in every 13; in 1871, the former would have equaled 1 in every 2 and the latter 1 in every 7. When these figures are compared with those of recent experience, and particularly with that of 1919, when the morbidity-rate was 535, the mortality-rate was 2, and the percentage of case-fatality was 0.78, the actual occurrence of any such rates of incidence of scarlet fever as those deduced for 1850 and 1871 seems impossible. Taking into account the fact that for more than 20 years before 1871 very high mortality-rates had been in almost constant vogue, on any low percentage of case-fatality there

could hardly have been a sufficient number of susceptibles in the population to permit such a high case incidence for a disease in which one attack as a rule confers lasting immunity. Therefore, the conclusion is unavoidable that during the period of high mortality the morbidity-rate must have been relatively low

TABLE 51.—*Number of cases and the rate of morbidity, per 100,000 living inhabitants in 1920, from scarlet fever and measles, according to age, color, and sex, for 1921.*

SCARLET FEVER.

C = cases. R = rate.

Age-groups.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	C	R	C	R	C	R	C	R	C	R	C	R	C	R
Under 1 year.....	7	47	6	47	2	30	4	64	1	51	...	...	1	99
1 to 4 years.....	238	437	233	484	119	493	114	476	5	78	3	96	2	61
0 to 4 years.....	245	353	239	392	121	394	118	272	6	72	3	74	3	70
5 to 9 years.....	481	746	459	813	210	735	249	894	22	273	14	363	8	190
0 to 9 years.....	726	542	698	595	331	558	367	632	28	170	17	214	11	129
10 to 19 years.....	261	211	249	231	108	204	141	257	12	75	10	141	2	22
20 to 29 years.....	64	44	62	52	27	46	35	58	2	8	1	8	1	7
30 to 39 years.....	11	9	11	11	7	14	4	8	...	...	...	...	...	...
40 to 49 years.....	2	2	2	3	...	...	2	5	...	...	...	...	...	...
50 to 59 years.....	1	2	1	2	...	...	1	4	...	...	...	...	...	...
Total	1065	145	1023	164	473	153	550	174	42	39	28	53	14	25

MEASLES.

Age-groups.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	C	R	C	R	C	R	C	R	C	R	C	R	C	R
Under 1 year.	75	505	72	559	33	500	39	621	3	152	1	104	2	198
1 to 4 years.	813	1492	800	1663	425	1760	375	1566	13	203	7	225	6	182
0 to 4 years.	888	1280	872	1430	458	1490	414	955	16	191	8	197	8	186
5 to 9 years.	1164	1805	1132	2006	571	1998	561	2015	32	397	12	311	20	475
0 to 9 years.	2052	1533	2004	1707	1029	1734	975	1679	48	292	20	252	28	329
10 to 19 years.	141	114	137	127	69	131	68	124	4	25	...	...	4	45
20 to 29 years.	29	20	27	23	13	22	14	23	2	8	1	8	1	7
30 to 39 years.	9	7	8	8	5	10	3	6	1	5	...	...	1	9
40 to 49 years.	2	2	2	3	1	3	1	3	...	...	...	...	...	...
50 to 59 years.	3	5	3	5	2	7	1	4	...	...	...	...	...	...
Total	2236	305	2181	349	1119	363	106	2335	55	51	21	39	34	61

and the case-fatality comparatively high, as compared with the experience of the last 20 years, when the reverse has held. It seems evident, therefore, that as the lethal force of scarlet fever has diminished, its invasive capacity has increased.

Morbidity-rates specific for color, sex, and age, in 1921 are given in table 51. Two-thirds of the reported cases were in individuals under the tenth year, and

of the remainder comparatively few were above the twentieth year of age. As with measles, the attack-rate was notably higher among whites than among negroes in every age-group, and in both races the incidence was greater during the second than during the first five years of life.

From a study of the monthly annual mortality-rates (table 49) and morbidity-rates (table 50) it is clear that, as a general rule, the incidence and fatality of scarlet fever are lowest in the warm months and highest in the colder months. In typical years these rates are lowest in June, July, August, and September, gradually increase through October, November, December, and January, to a peak reached in January or February, and then as gradually decline. The ascent and the decline in the rates are by no means always so gradual and uninterrupted. While the course of the curves for morbidity

TABLE 52.—*Maximum and minimum incidence of mortality and morbidity from scarlet fever, by months, from 1856 to 1899, inclusive, and from 1897 to 1920, inclusive, respectively, and the percentage of each to the total number of years.*

Months.	Months in 34 years in which maximum mortality-rate obtains.		Months in 34 years in which minimum mortality-rate obtains.		Months in 24 years in which maximum morbidity-rate obtains.		Months in 24 years in which minimum morbidity-rate obtains.	
	No.	Percentage to total years.	No.	Percentage to total years.	No.	Percentage to total years.	No.	Percentage to total years.
Jan.	9	26	...	...	9	38	...	...
Feb.	4	12	2	6	4	17	1	4
Mar.	2	6	4	12	1	4	...	...
Apr.	1	3	2	6	4	17	...	...
May	...	...	...	...	...	...	...	...
June	3	9	1	3	...	...	1	4
July	...	...	3	9	...	...	8	33
Aug.	...	...	7	21	...	...	8	33
Sept.	1	3	5	15	1	4	5	21
Oct.	1	3	7	21	1	4	...	...
Nov.	2	6	2	6	...	...	...	...
Dec.	11	32	1	3	4	17	1	4
Total ..	34	100	34	100	24	100	24	100

and mortality usually follow each other closely, the highest mortality by no means always occurred in the months of highest morbidity.

Maximum and minimum incidence of mortality and morbidity by months as experienced in percentages of occurrence in series of years is shown in table 52.

Maximum monthly mortality-rates occurred in percentages of the 34 years, 1856 to 1899, as follows: December 32, January 26, February 12, June 9, March and November, each, 6, April, September, and October, each, 3. Minimum monthly rates similarly expressed were distributed, August and October, each, 21, September 15, March 12, July 9, February, April, and November, each, 6, June and December, each, 3. Maximum rates in no year fell in May, July, or August, and May was the only month in which minimum rates have never occurred. Somewhat different was the relation of high and low morbidity occurrence in relation to months for the 24 years from 1897 to 1920.

The percentage of occurrence of maximum morbidity-rates by months was: January 38, February, April, and December, each, 17, and March, September, and October, each, 4. For minimum morbidity-rates, the percentage of occurrence by months was: July and August, each, 33, September 21, February, June, and December, each, 4. The highest monthly annual morbidity-rates never occurred in May, June, July, August, or November, and similarly the lowest rates were never met with in January, March, April, May, October, or November.

As after 1899, in many years, there were often no deaths in two or more months, it is not possible to compare the distribution of maximum and minimum monthly annual mortality- and morbidity-rates for the same series of years. As the effect of season upon mortality may, of course, depend upon other factors besides incidence of the disease, direct comparison of the results obtained in these two different series of years is not allowable. However, it is evident that, on the whole, since 1856 maximum morbidity and mortality of scarlet fever must have fallen in winter and spring and minimum morbidity and mortality in the summer and fall months.

While, unfortunately, they are incomplete in many important details, the data presented in the foregoing pages furnish materials of exceptional value for the elucidation of the natural history of scarlet fever over a period of 110 years. The more salient features of this history may be summarized as follows: It has not only been responsible for more deaths than any other member of this group, but it has been one of the most important single causes of mortality. It was only after repeated epidemic invasions that the disease became endemically established. From a disease of slight incidence and probably mild fatality in the earlier years of the nineteenth century, there was a gradual increase in mortality-rates to a high peak about 1860. Without the interpolation of restrictive measures in any form, there was a marked decline of mortality between 1860 and 1870. The mortality-rates ascended to a second high peak in 1880, and, again in the complete absence of restrictive measures, declined abruptly during the next 10 years, and gradually thereafter to a very low level by 1900. There was a continued, though relatively slight, decline in the mortality-rates during the next 20 years, in association with the use of restrictive measures.

But a hundred years of *laissez faire* had witnessed the ascent of this disease from a comparatively innocuous to one of the most fatal of affections, followed by a descent to a mortality-rate of almost negligible importance.

During the last 20 and probably the last 40 years, the morbidity-rates have increased as the mortality-rates have declined; in other words, the capacity of scarlet fever to attack the population has increased as its lethal force has diminished. During its state of endemicity, the tendency to periodic epidemic outbreaks has persisted.

During the past 65 years, very much the same seasonal incidence has been preserved. A very remarkable change has occurred in the ratio of mortality among negroes as compared with whites. In 1850 the mortality-rate for the former was only about one-fourth less than that for the latter, while during the past 15 years, the mortality was nearly three times greater among whites than among negroes.

Finally, in the 20 years of their trial, administrative measures directed to control the spread of scarlet fever have not been attended by any discernible positive influence upon morbidity.

MEASLES.

The date of the first appearance of measles in Baltimore is not recorded, and no direct references to its presence occurred before 1802. The inference that it was an epidemic visitant and not endemic in Baltimore Town in the eighteenth century is justified by certain statements of Nathaniel Potter (60) in a paper on the measles epidemics of 1802 and 1808. From Potter's statements it is clear that the disease appeared only in epidemic form in the first decade of the nineteenth century, and the figures in the tables of interments show that, so far as can be judged by recorded fatalities, this disease was not established endemically until about 1820. Referring in his paper to certain deviations noted in the characteristics of the disease in 1802 from the usual course of "morbillous fever," he stated, "as this epidemic disease observes nearly equidistant periods of visitation, appearing about once in 6 years, no occasion for further observation presented itself till 1808." The epidemic of the latter year, according to Potter, followed the spread of the disease across the counties of Maryland from Kent and Sussex Counties, Delaware, where it was recognized early in January 1808. By the middle of February the disease had invaded Caroline County, the eastern boundary of Maryland, and before the middle of April the whole peninsula was affected. It reached Baltimore the middle of May and continued to prevail until the middle of June, when apparently it died out completely.

As the disease had been present in Baltimore in 1802, Potter surmised that it could not now become generally epidemic and that the children born since the last epidemic would be the chief sufferers. On the contrary, this was not the case; usually only the older children and often only one in a family of children, who had not been previously exposed, contracted the disease. Many adults who escaped in 1802 were affected and suffered much more severely than children. In the epidemic of 1808 the disease departed from the usual inflammatory type, with coryza, conjunctivitis, sore throat, pains in the back and limbs, and pulmonary complications so characteristic, but was marked, almost invariably, by a "typhoid state" in which the patient lay in a dull stupor, insensible to every passing event, unless the eyes were affected. The period of fever and the time of the appearance of the eruption were very irregular. Some patients had a continued fever for 10 or even 15 days and no eruption. In some, the eruption appeared on the third or fourth day and in others not until the seventh, tenth, eleventh, thirteenth, or even the fifteenth day. Some individuals, after convalescing from an attack of continuous fever without eruption, were taken sick again after 20 days and had copious eruption. Two persons in the same house were seldom attacked simultaneously, but the second case generally took sick on the twentieth or twenty-first day from the indisposition of the first. Common complications were hemorrhage from the nose, occurring either before the onset of the fever or at a time of the eruption, and severe inflammation of the cornea or even the whole eye.

It may be said that measles in Baltimore in the first 20 years of the nineteenth century behaved as it now does in village and rural communities, i. e.,

as short-lived epidemics of greater or less severity, followed by periods in which the disease, in recognized form at least, entirely disappears. However, the epidemic of 1808 may have marked the period of the permanent residence of the disease in the city, for the absence for the records of deaths ascribed to it in 1811, 1812, 1814, 1817, 1818, and 1820 does not absolutely preclude its presence during those years, and the considerable death-rates of 1813 and 1819 may mark only exacerbations of endemic measles and not necessarily an epidemic due to a new importation of the disease. Much more likely, however, the disease died out completely in 1808, and a new epidemic invasion began 5 years later, in 1813, probably in connection with the mobilization of troops to defend the city, and after this date measles settled permanently in the city.

However this may be, after the outbreak of considerable severity in 1813 (table 34, graph 13) and that of moderate severity in 1815–1816, there came the much more fatal one of 1819, which was preceded by 2 years and followed by 1 year with no recorded fatalities. With slight fatalities in the next 2 years (1821 and 1822), the city experienced the most fatal measles epidemic of any single year of its history with a mortality-rate of 268, one that was preceded by 2 years of low rates and succeeded by 5 years of descending rates. This irregularity in the annual mortality rates is a characteristic retained throughout its subsequent history in Baltimore. Its course is marked by a series of peaks separated in no regular order by periods of 2, 3, 4, or even 5 years. Years of exceptionally high rates were as follows: 1819, 209; 1823, 268; 1837, 129; 1852, 181; 1857, 103; 1869, 85. Years of moderately high rates were: 1829, 56; 1834, 78; 1842, 80; 1846, 78; 1854, 54; 1862, 68; 1864, 60; 1868, 75; 1869, 85; 1884, 62; 1886, 53; 1890, 57. Since 1893, the rate has never been above 20. But though the rates have fallen so conspicuously since 1890, the tendency of the annual rates to describe wide fluctuations has never been wholly lost.

The curve of the annual rates averaged for 5-year periods (table 43, graph 14) describes a remarkable and, in some ways, characteristic course. Whether the level of mortality be high or low, the curve is marked by a succession of peaks and depressions, which recur with unfailing regularity. Beginning with a rate of 24 for the 5-year period ending in 1815, the rate rose to 45 in 1816–1820 and to 62 in 1821–1825 and fell sharply to 14 in 1826–1830. Reacting in 1831–1835 to 25 and in 1836–1840 to 42, the rate fell to 21 in 1844–1845. The rate then rose to 31 in 1846–1850 and to 53 in 1851–1855, fell to 41 in 1856–1860 and to 29 in 1861–1865. For the next 5-year period the rise was sharp to 44, and the succeeding fall was gradual to 30 in 1871–1875 and to 15 in 1876–1880. The rate now stood at the level of 50 years before. This gain was not permanent, however, for the rate rose to 29 in 1881–1885 and to 35 in 1886–1890. Falling to 11 in 1891–1895 and to 5 in 1896–1900, instead of following its usual course, it fluctuated between 6 to 8 during the next 20 years.

In the rates averaged for 10-year periods (table 43, graph 15), the rate rose from 35 in 1812–1820 to 38 in 1821–1830 and then fell to 33 in 1831–1840 and to 26 in 1841–1850. Rising again to 47 in 1851–1860, it fell to 36 in 1861–1870 and to 22 in 1871–1880. Reacting to 32 in 1881–1890, the rate fell sharply to 8 in 1891–1900, and but slightly to 7 in 1901–1910. During the last 10 years it remained stationary.

It is clear, therefore, from an analysis of the course of the mortality-rates, that the lethal force of measles has experienced very considerable modifications during the 108 years under review. After increasing very considerably between 1812 and 1825, it diminished during the next 10 or 15 years and then with renewed vigor rose to a still higher level between 1850 and 1860. Then after a period of gradual decline covering about 20 years, between 1880 and 1890, for a third time it regained strength. This final effort was short-lived and relatively weak, and by 1895 the lethal force of this disease had become comparatively impotent. During the past 25 years the mortality-rate has tended to stabilize around an unprecedently low level. It will be shown later that in the decennial years 1910 and 1920 nearly the whole of the mortality from measles was confined to the first decade of life. Assuming, as is probably not far from actual occurrence, that this held constantly, rates calculated for the census years 1830 to 1920, inclusive, on the basis of the populations under the tenth year of life, and thus corrected in large measure for changes in the age distribution of the population, should give a much more accurate picture of the changes in the lethal force of the disease. Rates specific for age so calculated are given in table 44. From these it appears that the course of mortality of measles in this period was characterized by four distinct waves, with the peaks of the third and fourth much lower than that of the second, which was in turn considerably higher than the highest level of the first. It is clear that mortality attained its highest level about 1870, and that since that date it has declined sharply, though in irregular fashion, to a comparatively low point.

Data for morbidity are available by months and years since 1897. While case reporting has never been complete, the figures since 1900 are fairly representative. The considerable increase in morbidity-rates since 1905 (table 53), probably represents an actual increase in prevalence. The annual morbidity-rates, like those for mortality during this period, are marked either by alternate years of high and low levels or by comparatively high rates for 2 or 3 years in series.

The annual rates for morbidity and mortality as a rule rise and fall, at least in the same direction, though by no means always in proportion, for a heavy case incidence is not by any means always associated with a correspondingly great increase in the number of deaths.

The case-fatality, then, it will be observed may be higher or lower than the average with either a high or low morbidity-rate. The case-fatality rate varied from 0.63 per cent to 3.38 per cent.

From the monthly annual morbidity- and mortality-rates (tables 53 and 54), it is seen that, with few exceptions, the incidence and mortality of measles have been lowest in July, August, September, October, and November, and highest in December, January, February, March, April, May, and June. This characteristic distribution of the disease has held in years of both high and low incidence.

The influence of season upon the morbidity and mortality as expressed in the months in which maximum and minimum monthly annual morbidity-rates fell, from 1897 to 1920, and in which maximum mortality-rates occurred from 1856 to 1920, is shown in table 55. Maximum morbidity-rates occurred in percentages of the total of 24 years, as follows: May 33, April 25, December 21,

TABLE 53.—*Morbidity by months and years and monthly annual and annual rates of morbidity, per 100,000 living inhabitants, from measles, from 1897 to 1920, inclusive.*

C = cases. R = rate.

Year.	Jan.		Feb.		Mar.		April.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total.			Percentage case fatality.	
	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	Average rate of morbidity by 5-yr. periods.	Annuals.	Average by 5-year periods.
1897	7	17	2	5	65	158	137	343	110	267	81	203	49	119	12	29	1	3	28	68	62	155	105	254	659	136	.....	2	.....
1898	95	227	167	442	277	662	279	689	286	683	174	429	71	170	18	43	9	22	5	12	13	32	25	60	1419	288	.....	3	.....
1899	46	108	53	138	26	61	40	97	96	226	139	338	49	115	10	24	11	27	5	12	30	73	89	210	594	119	.....	1	.....
1900	467	1085	796	2047	702	1630	379	910	255	592	89	214	31	72	10	23	3	7	16	37	14	34	8	19	2770	546	272	1	2
1901	29	66	56	142	74	170	79	187	121	277	56	133	10	23	1	2	3	7	14	32	10	24	13	30	466	91	.....	1	.....
1902	20	45	30	75	29	66	51	119	62	140	104	243	86	194	29	66	23	54	100	226	416	972	959	2168	1909	367	.....	2	.....
1903	1235	2757	550	1359	237	529	82	189	44	98	21	48	9	20	4	9	3	7	6	13	6	14	6	13	2203	417	.....	4	.....
1904	17	37	15	37	30	66	40	91	108	238	48	109	19	42	12	26	8	18	3	7	9	21	35	77	344	64	.....	2	.....
1905	42	91	80	193	387	843	683	1537	744	1620	330	743	89	194	26	57	20	45	3	7	16	36	17	37	2437	451	278	3	2
1906	24	52	14	33	26	56	69	153	124	267	115	256	30	65	27	58	9	20	28	60	37	82	72	155	575	105	.....	2	.....
1907	214	455	327	770	495	1053	503	1105	321	683	134	295	91	194	24	51	8	18	10	21	70	154	71	151	2268	410	.....	3	.....
1908	109	229	228	531	547	1150	431	937	265	557	74	161	33	69	12	25	5	11	8	17	61	133	122	257	1895	338	.....	1	.....
1909	284	591	448	1032	576	1198	714	1534	546	1136	246	529	90	187	8	17	8	17	11	23	28	60	40	83	2999	530	.....	2	.....
1910	86	177	101	230	130	267	134	285	134	276	87	185	55	113	16	33	29	62	37	76	102	217	226	465	1137	199	316	2	2
1911	430	875	599	1350	1066	2170	613	1290	439	894	271	570	82	167	18	37	5	11	8	16	10	21	35	71	3576	618	.....	2	.....
1912	37	75	38	85	57	115	51	106	80	161	80	167	52	105	17	34	11	23	17	34	32	67	152	306	624	107	.....	1	.....
1913	224	447	738	1630	1768	3528	1815	3743	837	1670	196	404	80	160	21	42	5	10	11	22	14	29	15	30	5724	970	.....	2	.....
1914	40	79	55	120	88	174	124	253	71	140	30	61	32	63	6	12	7	14	6	12	4	8	3	6	466	78	.....	1	.....
1915	11	22	25	54	78	153	166	336	275	538	338	684	119	233	37	72	17	34	17	33	126	255	637	1251	1846	307	416	1	1
1916	739	1434	973	2090	1294	2510	1081	2167	800	1552	331	664	125	242	26	50	17	34	4	8	7	14	10	19	5407	891	.....	1	.....
1917	25	48	120	255	411	790	872	1733	1405	2701	825	1639	245	471	61	117	45	89	28	54	65	129	144	277	4246	693	.....	1	.....
1918	385	734	569	1201	1672	3187	2496	4917	1738	3313	446	879	102	194	27	51	7	14	3	6	7	14	30	57	7482	1211	.....	1	.....
1919	55	90	55	99	64	104	148	250	99	162	60	101	16	26	13	21	16	27	33	54	48	81	218	356	825	114	.....	1	.....
1920	481	772	584	1037	762	1223	1083	1796	1177	1889	587	973	156	250	38	61	28	46	26	42	43	71	74	119	5039	687	719	1	1

TABLE 54.—*Number of deaths by months and years and monthly annual and annual rates of death, per 100,000 living inhabitants, from measles, from 1856 to 1920, inclusive.*

D = death. R = rate.

Year.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1856	...	...	...	...	...	...	1	6	1	6	1	6	3	18	1	6	1	6	...	...	...	...	...	...	8	4
1857	5	30	12	79	29	172	44	270	52	308	30	178	5	30	17	101	3	18	1	6	5	31	2	12	205	103
1858	4	23	5	32	2	12	2	12	4	23	5	30	8	46	3	17	2	12	1	6	1	6	2	12	39	19
1859	...	...	1	6	5	28	5	29	3	17	10	58	12	68	10	56	1	6	3	17	3	17	4	23	57	27
1860	11	60	4	24	14	77	13	74	19	104	24	136	10	55	9	49	3	17	...	...	2	11	...	...	109	51
1861	2	11	...	...	...	...	...	...	...	...	...	...	1	5	...	...	...	...	3	16	2	11	3	16	11	5
1862	18	94	18	104	25	131	16	86	17	89	19	103	18	94	9	47	6	32	2	10	2	11	4	21	154	68
1863	1	5	1	6	10	51	...	...	3	15	...	...	1	5	...	...	1	5	...	...	...	...	...	...	17	7
1864	3	15	5	28	19	94	37	190	35	174	22	113	11	55	4	20	2	10	...	...	1	5	4	20	143	60
1865	1	5	1	5	...	...	...	...	...	...	3	15	3	15	1	5	...	...	...	...	...	...	2	10	11	5
1866	4	19	...	...	7	33	9	44	17	81	18	88	34	161	12	57	2	10	1	5	...	...	1	5	105	42
1867	2	9	...	...	...	...	...	...	...	...	1	5	1	5	3	14	1	5	...	...	...	...	...	...	8	3
1868	...	...	...	...	1	5	...	...	6	27	10	47	16	72	32	145	12	56	12	54	27	126	80	362	196	75
1869	76	336	64	313	44	194	11	50	13	57	8	37	1	4	3	13	4	18	1	4	...	...	2	9	227	85
1870	6	26	5	24	4	17	...	...	7	30	1	4	1	4	1	4	1	4	4	17	3	13	2	9	35	13
1871	2	8	2	9	...	...	...	...	4	17	3	13	19	80	23	97	14	61	6	25	17	74	21	89	111	40
1872	42	173	32	146	21	87	25	107	11	45	5	21	7	29	1	4	8	34	3	12	3	13	3	12	161	56
1873	7	28	3	13	5	20	1	4	...	...	7	29	6	24	6	24	3	13	5	20	1	4	2	8	46	16
1874	2	8	6	26	12	47	11	45	16	63	15	61	9	36	4	16	6	24	2	8	5	20	5	20	93	31
1875	2	8	1	4	...	...	1	4	1	4	7	28	1	4	2	8	...	...	...	...	...	...	...	...	15	5
1876	2	8	2	8	...	...	...	...	1	4	...	...	...	...	...	...	1	4	...	...	1	4	9	34	16	5
1877	15	56	22	90	46	170	37	142	12	44	7	27	7	26	...	...	2	8	1	4	1	4	1	4	151	47
1878	...	...	...	...	5	18	2	7	3	11	1	4	...	...	...	...	...	...	...	...	...	...	...	...	11	3
1879	2	7	3	12	3	11	7	26	5	18	8	29	9	32	3	11	1	4	2	7	...	...	...	...	43	13
1880	...	...	...	...	1	3	...	...	1	3	1	4	6	21	2	7	1	4	...	...	...	...	...	...	12	4
1881	1	3	1	4	3	10	10	35	25	85	13	46	14	48	4	14	4	14	...	...	...	...	...	...	75	22
1882	...	...	2	7	2	7	3	10	17	57	17	59	18	60	7	23	1	3	...	...	2	7	2	7	71	20
1883	3	10	2	7	4	13	5	17	6	20	19	64	23	75	12	39	8	27	3	10	8	27	37	121	130	36

1884	50	160	39	139	58	186	33	109	34	109	5	17	6	19	...	...	...	...	...	...	1	3	2	6	228	62
1885	1	3	...	...	...	...	1	3	...	...	1	3	5	16	3	9	1	3	...	...	3	10	1	3	16	4
1886	5	15	7	24	16	48	35	112	64	194	46	147	22	67	4	12	1	3	1	3	...	...	...	...	201	53
1887	1	3	5	17	7	21	5	16	4	12	8	25	7	21	4	12	...	...	3	9	10	31	31	94	85	22
1888	21	59	35	109	49	138	30	87	20	56	12	35	4	11	2	6	1	3	...	...	...	...	2	6	176	42
1889	...	...	1	3	1	3	...	...	1	3	2	6	...	...	1	3	...	...	...	...	...	...	5	14	11	3
1890	31	84	37	111	83	225	39	109	31	84	19	53	6	16	1	3	1	3	...	...	...	...	...	...	248	57
1891	5	13	...	...	2	5	...	...	2	5	...	...	1	3	...	...	...	...	...	...	3	8	3	8	16	4
1892	6	16	9	26	11	29	15	41	31	81	19	51	7	18	6	16	1	3	2	5	3	8	10	26	120	27
1893	2	5	4	11	4	10	12	32	8	21	7	19	1	3	...	...	1	3	...	...	...	...	...	...	39	9
1894	1	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	5	...	...	...	...	3	1
1895	...	...	2	6	...	...	4	10	4	10	10	26	13	32	5	12	1	3	2	5	5	13	22	55	68	14
1896	8	20	11	30	3	7	2	5	1	2	...	...	1	2	...	...	1	3	...	...	...	...	...	...	27	6
1897	1	2	...	...	...	...	5	13	3	7	3	8	1	2	...	...	1	3	...	...	1	3	1	2	16	3
1898	1	2	7	19	5	12	6	15	9	22	12	30	5	12	3	7	...	...	...	...	...	...	...	...	48	10
1899	2	5	1	3	...	...	1	2	...	...	1	2	...	...	...	...	...	...	...	...	...	...	...	...	5	1
1900	3	7	4	10	4	9	6	14	1	2	4	10	1	2	1	2	...	...	...	...	...	...	...	...	24	5
1901	...	...	...	...	...	...	...	...	...	...	2	5	...	...	...	...	...	...	1	2	...	...	...	...	3	1
1902	...	...	...	...	1	2	3	7	2	5	6	14	8	18	3	7	...	...	4	9	4	9	13	29	41	8
1903	26	58	21	52	14	31	5	12	5	11	...	...	3	7	...	...	...	...	...	...	2	5	1	2	77	15
1904	...	...	1	2	...	...	...	...	...	...	1	2	1	2	1	2	1	2	...	...	...	...	1	2	6	1
1905	...	...	...	...	3	7	12	27	13	28	17	38	5	11	3	7	7	16	3	7	...	...	4	9	67	12
1906	...	...	1	2	...	...	1	2	3	6	1	2	1	2	1	2	...	...	6	13	...	...	...	...	14	3
1907	4	9	5	12	14	30	21	46	12	26	1	2	...	...	3	6	1	2	1	2	1	2	11	23	74	13
1908	1	2	2	5	3	6	5	11	2	4	...	...	...	...	1	2	1	2	...	...	...	...	2	4	17	3
1909	2	4	5	12	6	12	14	30	12	25	9	19	1	2	2	4	...	...	2	4	...	...	1	2	54	10
1910	1	2	5	11	3	6	...	...	...	...	4	9	1	2	1	2	...	...	...	...	1	2	3	6	19	3
1911	6	12	9	20	19	39	19	40	12	24	2	4	8	16	...	...	...	...	...	...	2	4	...	...	77	13
1912	...	...	...	...	1	2	...	...	...	...	...	...	1	2	2	4	...	...	...	...	...	...	1	2	5	1
1913	2	4	10	2	22	44	27	56	28	56	8	17	3	6	5	10	1	2	2	4	...	...	10	20	118	20
1914	3	6	1	2	1	2	...	...	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	1
1915	...	...	1	2	...	...	2	4	1	2	1	2	1	2	1	2	1	2	1	2	3	6	5	10	17	3
1916	5	10	7	15	8	16	7	14	5	10	1	2	1	2	...	...	...	...	...	...	...	...	...	...	34	6
1917	1	2	...	...	6	12	8	16	8	15	12	24	2	4	3	6	4	8	1	2	4	8	2	4	51	8
1918	3	6	5	11	17	32	15	30	20	38	8	16	5	10	1	2	1	2	...	...	...	...	...	...	75	12
1919	...	...	1	2	...	...	3	5	...	...	...	...	...	...	...	...	1	2	...	...	...	...	2	3	7	1
1920	2	3	2	4	11	18	4	7	13	21	10	17	3	5	1	2	1	2	1	2	1	2	...	...	49	7

March 13, January 8. The months of occurrence of minimum rates similarly expressed stood in order as follows: September 38, October 29, August 17, January 13, November 4. It is very clear that conditions which obtain in September, October, August, January, and November, in the order named, are least favorable, and those which obtain in May, April, December, and March are most favorable to the incidence of this disease. It will be observed that the maximum and minimum rates not infrequently fell in January. The highest incidence in no year fell in February, June, or July. The percentage of months in the 65 years in which the maximum mortality occurred were June 15, April and July 14, March 11, January, December, and May 9, February 8, August 6, and October 5. In no year was September or November the month of maximum mortality.

TABLE 55.—*Maximum incidence of mortality and maximum and minimum incidence of morbidity from measles by months, from 1856 to 1920, inclusive, and 1897 and 1920, inclusive, respectively, and the percentage of each to the total number of years.*

Months.	Months in 65 years in which maximum mortality-rate obtains.		Months in 24 years in which maximum morbidity-rate obtains.		Months in 24 years in which minimum morbidity-rate obtains.	
	No.	Per cent to total years.	No.	Per cent to total years.	No.	Per cent to total years.
Jan.	6	9	2	8	3	13
Feb.	5	8	...	...	...	...
Mar.	7	11	3	13	...	...
Apr.	9	14	6	25	...	...
May	6	9	8	33	...	...
June	10	15	...	...	...	...
July	9	14	...	...	...	...
Aug.	4	6	...	...	4	17
Sept.	...	...	...	...	9	38
Oct.	3	5	...	...	7	29
Nov.	...	...	...	...	1	4
Dec.	6	9	5	21	...	...
Total	65	100	24	100	24	100

When the courses of the monthly annual morbidity- and mortality-rates from 1897 to 1920 (tables 53 and 54) are compared, it is noted that while, in general, the mortality-rates rise and fall very closely with the morbidity-rates, this is by no means always the case.

The shape of the curve of the monthly annual morbidity-rates varies greatly from year to year. A rise beginning from a low point in September or October may proceed gradually and smoothly, uninterruptedly or sharply and smoothly, to a peak in the winter or spring. The peak may be sharp or flat. The descent in the curve may be sharp or gradual. The low point reached in the different years often varies within comparatively wide limits.

The influence of color, age, and sex on the incidence of measles can not be determined from the records of reported cases before 1921.

Rates specific for these attributes for this year are given in table 51. It will be observed that while the great majority of reported cases, 2,052 out of a total of 2,236, were in individuals under the tenth year, 141 were in the second

decade and the remainder were between the twentieth and fifty-ninth year of life. Whether comparison be made in the rates for all ages or for the separate age-groups, the attack-rate is seen to be much greater in whites than in negroes. For the age-groups 0 to 9 years it was greater by 425 per cent. In this year all of the 27 deaths ascribed to measles were in this group and the mortality-rates for whites and for negroes were 21 and 12, respectively, or 75 per cent higher in the latter than in the former. The case-fatality rate was 200 per cent higher in negroes, 3.6 as opposed to 1.4 per cent. It would appear, then, that either case reporting was much less complete among negroes or with a much lower incidence rate than the white, the negro, when he does develop the disease, resists it and its lethal complications much less well. In both races and sexes the morbidity was considerably higher in the second than in the first 5 years of life; as between the sexes the rates were, on the whole, higher in males than among females in whites and among females than among males in negroes.

Of the 628 deaths credited to the disease during the 15-year period 1905–1919 (table 46), 497 were in whites and 131 in negroes, or in a ratio of approximately 4 to 1, while the proportion of white to negroes averaged 5.42 to 1; from which it appears that measles in Baltimore is somewhat more fatal in the former than in the latter race. Among the whites the deaths were 263 in males as compared with 234 in females, while among the negroes there were 67 deaths in males to 62 in females, indicating a higher mortality in males than in females in both races, with no great difference in the proportions of the number of deaths of males and females in the two races.

The distribution of the deaths from measles for age by sex and color, as of 1910 (table 47), based on numbers too small to warrant generalizations, shows even higher mortality-rate for males than females. From table 48 in which rates specific for these categories are given for 1920, and which are based on larger figures than those for 1910, it will be noted that, as in the latter year, the deaths were confined to the first decade and that nearly the whole mortality occurred in the first five years of life. Whereas in 1920 in the various age-groups in which deaths were recorded there was considerable variation in the rates for the two races and sexes, the mortality for the first decade of life as a whole varied but slightly for these several categories.

This remarkably interesting disease, having often invaded Baltimore in the form of sharply marked epidemics, which after running a short course apparently died out, became endemically established as a permanent resident about 1819. Since that date it has run a definite endemic course, broken from time to time by superimposed severer outbreaks, and finally, after about 90 years, has reached an average low rate of mortality which has become stabilized since 1900. That this course has been determined by the interaction of the disease upon the population and not by interferences directed to this end by the activities of the health department is clear from the facts that the fall in the mortality-rates was substantial long before the disease was made reportable by a law (1894) which has never been complied with with any completeness, that it was not until well after 1910 that the health department made any serious attempt to restrict its spread by isolation, and that all the evidence at hand indicates that such efforts as have been made to this end have been on the

whole barren of results. If morbidity-rates during the last 20 years prove anything, it is that the incidence has increased, while the case-fatality rate on the whole has fallen.

INFLUENZA.

Epidemics of influenza are said by Quinan to have occurred in Baltimore in 1789 and in 1807, but there have been preserved no definite records of their duration or extent in morbidity and fatality. In the former year the disease was popularly called "putrid cold." Influenza (table 34, graph 11) was credited in the table of interments with 25 deaths in 1815, a death-rate of 53, and again in 1818 with 2 deaths. This disease is not mentioned again until 1831 and 1832, when there occurred a severe epidemic, beginning in December and lasting through April, causing 11 deaths in the former and 114 deaths in the latter year, with death-rates of 12 and 124, respectively. A few deaths are recorded from the disease again in 1834, 1835, 1843, 1845, 1849, and 1850 (with death-rates of 9, 13, 7, 1, 3, and 1, respectively), and then, with the exception of a single death in each of the years 1879 and 1881, it disappeared completely as a recorded cause of death until 1890.

Whether or not the disease died out completely between 1835 and 1843 or remained as an endemic affection is not known. Medical men living 15 years ago recalled with distinctness the outbreak of 1849 as widely diffused in the population and as more fatal than is suggested by the number of deaths ascribed to it in the statistical records.

It is more than probable that in all these years the deaths ascribed to influenza fell short of the true number. The disease, in definitely recognizable form at least, seems to have died out completely during the 40 years beween 1851 and 1890, and the single deaths in 1879 and 1881 are probably to be ascribed to errors in diagnosis. Certain it is that the epidemic of 1890 took all of the local physicians by surprise, except the few remaining who had gone through the epidemic of 1849. The disease had so entirely disappeared from local medical nosology that even the name was new to the great bulk of practitioners, and professors of medicine had long since omitted consideration of it in their lectures.

When the disease reappeared in 1890 with a high degree of incidence and a weak lethal capacity, it exhibited the characteristics of 1849, rather than those of 1815 and 1831–1832. But in the succeeding years it displayed a quality entirely new. Instead of dying out after a year or two, the disease persisted in endemic state, and in no subsequent year did it fail to be credited with deaths. Upon this endemic basis there have occurred a number of short waves of comparatively high mortality-rates. These waves have recurred in a rather irregular fashion and their crests have occupied usually only 1 but occasionally 2 years.

Until 1918 the annual mortality-rates were never excessive as compared with those often attained by other members of the group. The highest rate, 55, occurred in 1891; rates of 42, 39, 46, 25, and 31 were attained in other years. The lowest annual rates were 5 in 1902 and 8 in 1913. Between 1909 and 1917, inclusive, the highest recorded rate was 21.

The rate bounded to 282 in 1918, and for 1919 and 1920 the rates were 56 and 44, respectively. Particularly in regard to the spread of the peaks and

depressions as related to groups of years and to the character of the fluctuations in the rates, the curve of the annual rates for influenza resembles that for scarlet fever more closely than that for any other member of this group. The contrast between the course of the disease in its purely epidemic state and in its endemic state is well brought out in the comparison between the annual mortality rates as averaged for 5-year periods (table 43, graph 12). With rates of 13 for 1812–1815 and of 32 for 1831–1835 and negligible rates for all the intervening periods, the averaged rates were for 1891–1895, 36; 1896–1900, 21; 1901–1905 and 1906–1910, 17; 1911–1915, 13; and 1916–1920, 84.

The great influenza epidemic of 1918 finds no analogies in either scarlet fever or measles, and the closest approach to it among other diseases of this group after they had become endemic is that of small-pox in 1858.

It will be observed that, during the period of endemicity, the chief incidence of the disease as expressed in deaths (table 56) is in winter and spring, and that, though deaths occasionally occur in July, August, September, and October, they are comparatively few in number, that deaths increase in number in December, and that the greatest fatality more often falls in February than in any other month. To this last point there were, however, many exceptional years when the highest fatality occurred in January, March, or even April or May. As pointed out above, in these respects measles and influenza behave very similarly. In the 31 years, 1890 to 1920, the maximum monthly annual mortality-rate, as expressed in percentages of the total number of years, occurred as follows, January 29, February 32, March and April, each 13, December 10, October 3.

The records contain a considerable amount of instructive information concerning three of the great epidemics of influenza in Baltimore.

In 1831–1832, the weekly deaths from influenza and from all causes were published in the *Baltimore American and Commercial Advertiser,* and from this source it has been possible to construct table 57 in which the course of this epidemic is well illustrated.

The epidemic began apparently about the middle of December 1831, and lasted until the end of April at least. By December 31 it had spread widely, though it was not very fatal, for "many families have had six or eight sick at once, yet but few of these cases have ended fatally." The highest number of deaths recorded in any one month was in January, and in any one week in that ending the 17th of that month. As measured in calendar months, there was a rapid rise during December and January, followed by an abrupt fall in February, with a slight descent from the level of the latter during March, and a final decided drop during April. During the whole epidemic period about 12.8 per cent of the whole number of deaths was attributed to influenza.

There are no data in regard to the number of cases, but from the information in hand, it seems probable that the disease was very widespread, with a relatively low case fatality.

The epidemic of 1890 began about the middle of January and spread rapidly through the city, affecting a very large proportion of the population; but, unlike that of 1831–1832 and that of 1918, it did not affect whole families at a time. No deaths were credited to the disease during this month. The acme of the epidemic was during February, when the physicians in both private

TABLE 56.—*Number of deaths by months and years and the monthly annual and annual rates of death, per 100,000 living inhabitants, from influenza, from 1890 to 1920, inclusive.*

D = death. R = rate.

Year.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1890	...	...	10	30	5	14	...	...	2	5	...	...	...	...	...	...	...	...	....	....	...	...	...	...	17	4
1891	2	5	1	3	4	11	31	85	73	194	23	63	...	...	...	...	...	...	1	3	...	...	109	290	244	55
1892	117	307	31	90	30	79	8	22	4	10	...	...	...	...	...	...	...	...	....	....	...	...	...	...	190	42
1893	2	5	4	11	2	5	8	21	...	...	...	...	1	3	...	...	...	...	....	....	1	3	44	113	62	14
1894	59	150	36	101	18	46	10	26	6	15	1	3	1	3	...	...	...	...	....	....	3	8	1	3	132	28
1895	11	27	42	116	70	175	36	93	14	35	3	8	3	7	2	5	...	...	....	....	3	8	1	3	185	41
1896	5	12	10	27	18	44	21	53	3	7	1	3	...	...	...	...	1	3	....	....	1	3	...	...	60	13
1897	10	24	34	91	28	68	9	23	2	5	...	...	1	2	1	2	3	8	....	....	...	...	...	...	88	18
1898	1	2	4	11	4	10	8	20	...	...	...	...	3	7	2	5	1	2	1	2	1	2	45	107	70	14
1899	140	330	40	104	27	64	9	22	6	14	1	2	2	5	2	5	...	...	2	5	1	2	1	2	231	46
1900	9	21	5	13	19	44	21	50	13	30	3	7	2	5	2	5	1	2	....	....	1	2	1	2	77	15
1901	24	55	53	134	28	64	8	19	8	18	1	2	1	2	...	...	...	...	....	....	1	2	4	9	128	25
1902	10	23	3	8	4	9	3	7	3	7	...	...	1	2	...	...	...	...	....	....	2	5	2	5	28	5
1903	11	25	32	79	29	65	6	14	7	16	2	5	...	...	...	...	...	...	....	....	2	5	3	7	92	17
1904	4	9	33	81	47	104	17	39	10	22	3	7	1	2	1	2	...	...	2	4	...	...	4	9	122	23
1905	10	22	32	77	25	54	8	18	5	11	1	2	...	...	...	...	1	2	....	....	5	11	4	9	91	17
1906	8	17	10	24	19	41	6	13	5	11	...	...	1	2	1	2	...	...	....	....	...	...	4	9	54	10
1907	30	64	26	61	16	34	7	15	2	4	3	7	1	2	...	...	...	...	....	....	2	4	18	38	105	19
1908	112	236	22	51	12	25	8	17	4	8	...	...	1	2	...	...	1	2	2	4	2	4	9	19	173	31
1909	11	23	8	18	17	35	27	58	6	12	3	6	1	2	...	...	...	...	....	....	1	2	5	10	79	14
1910	24	49	20	46	12	25	5	11	4	8	3	6	...	...	1	2	1	2	....	....	...	...	2	4	72	13
1911	24	49	26	59	11	22	13	27	5	10	1	2	...	...	...	...	...	...	4	8	...	...	2	4	86	15
1912	14	28	7	16	25	50	11	23	...	...	1	2	...	...	...	...	1	2	2	4	2	4	8	16	71	12
1913	11	22	12	27	8	16	5	10	1	2	1	2	1	2	...	...	...	...	2	4	2	4	5	10	48	8
1914	15	30	16	35	17	34	9	18	4	8	3	6	2	4	2	4	1	2	....	....	1	2	2	4	72	12
1915	11	22	7	15	20	39	31	63	10	20	5	10	...	...	...	...	...	...	1	2	3	6	9	18	97	16
1916	49	95	34	73	20	39	5	10	2	4	1	2	5	10	1	2	...	...	3	6	2	4	7	14	129	21
1917	23	44	24	51	20	38	12	24	3	6	1	2	1	2	2	4	2	4	1	2	6	12	13	25	108	18
1918	24	46	14	30	20	38	12	24	6	11	2	4	1	2	...	...	11	22	1464	2791	93	183	94	179	1741	282
1919	187	305	124	224	50	82	12	20	7	11	4	7	2	3	...	...	7	12	4	7	4	7	5	8	406	56
1920	24	39	234	416	34	55	9	15	5	8	1	2	2	3	2	3	1	2	1	2	5	8	6	10	324	44

practice and in dispensaries were overburdened. The fatalities attributed to the disease were only 10, a comparatively small number in comparison with the large number of cases. There was, however, a decided increase in the number of deaths from all causes and from pneumonia, bronchitis, and pulmonary tuberculosis. As a conspicuous cause of death, influenza did not show its force until 1891 and 1892. After the drop in the morbidity-rate in 1893, the disease settled into an endemic state, and in lethal capacity never reached its previous level until 1918.

The course of influenza during the first 8 months of 1918 was not unusual, except in one feature, namely, the occurrence during February and March among some men living in the eastern section of the city and working daily in the government construction camps just without the city limits of a type of influenza characterized by acute laryngitis, often complicated by severe hemorrhage. Though the affection often attacked the household associates of

TABLE 57.—*Number of deaths and rate of death, per 100,000 living inhabitants, from influenza and all causes, by weeks, for 1831 and 1832.*

D = death. R = rate.

Week ending.	Influenza.		All causes.		Week ending.	Influenza.		All causes.	
	D	R	D	R		D	R	D	R
1831					1832				
Dec. 19...	2	117	49	2875	Feb. 21...	3	170	52	2943
Dec. 27...	9	528	57	3344	Feb. 28...	10	566	60	3396
1832					Mar. 5...	9	509	59	3339
Jan. 3...	13	736	60	3396	Mar. 12...	3	170	58	3282
Jan. 10...	12	679	58	3282	Mar. 20...	8	453	60	3396
Jan. 17...	15	849	55	3113	Mar. 27...	4	226	51	2886
Jan. 24...	4	226	44	2490	Apr. 3...	5	283	48	2716
Jan. 31...	10	566	49	2773	Apr. 10...	4	226	49	2773
Feb. 7...	9	509	52	2943	Apr. 17...	...	...	43	2434
Feb. 14...	3	170	49	2773	Apr. 24...	2	113	27	1528

these men; it spread to other households but rarely. Both lobar and broncho pneumonia were more prevalent than usual in the spring of 1918, and a considerable proportion of the cases of pneumonia, complicating cases of measles and whooping-cough during the winter and spring months, conformed to the type of acute interstitial pneumonia described by MacCallum and others in army camps and associated with the presence of *Streptococcus hemolyticus*. This highly fatal type of pneumonia had become well established in the city before the beginning of the great influenza-pneumonia epidemic in September. During the latter part of August and early September there was a sharp outbreak of influenza among the military and labor forces in the construction and other army camps to the east and southeast of the city, and during the third week of September, just as in the spring, cases of the disease in very severe type occurred first in the eastern section of the city among men residing there, but working in the army camps, where they came into contact with the army personnel. The disease spread first to the household associates of these men, and then within a short time over the whole eastern section of the city. In the last week of September, influenza of the same severe type appeared in the

southern section of the city, bounding the west side of the basin and harbor, the seat of shipyards and docks, where the inhabitants were most intimately associated with overseas shipping. In a short time the disease spread rapidly in the neighboring wards. It is clearly established that the malady first attacked, in severe form, at least, those whose work brought them into association with the army. The wards of the north and northwestern sections of the city were invaded somewhat later. There were probably early in the epidemic a number of foci in various parts of the city that did not come so sharply to the attention of the health department.

Influenza was included among the reportable diseases shortly after the beginning of the epidemic, and the first cases (10 in number) were reported on September 26. Between this date and December 27, 21,902 cases were reported, but, as it was for some weeks a physical impossibility for an overworked profession to report cases with any degree of completeness, it is probable that but one-third of the actual number of cases was reported and that 75,000 would be an underestimate. From the daily record it appears that the peak of the epidemic was reached about October 10, when the highest number of case reports (1962) was received. By October 29 the daily number of case reports had fallen to 514, and by the 31st to 90. During November the number fell to a lower level. There was a distinct rise in December, which became more marked at the close of the month.

The course of the disease by weeks from September 7, 1918, to April 25, 1919, is shown by the weekly annual rates for influenza, together with the weekly annual rates for deaths from all causes, in table 58. The curves for these rates, with the rapid rise to a high peak, between the week ending September 28, and the weeks ending October 12 and 19, for morbidity and mortality respectively, and the succeeding declines, almost as sharp, reaching a low point the last week in November, are distinctive and entirely unlike those of previously recorded epidemics of influenza in Baltimore. The curves for the ensuing winter and spring followed the usual endemic course, very much as if this overwhelming outbreak of September, October, and November had not occurred. This outbreak was for Baltimore exceptional in its season of occurrence, the rapidity of its course, and its high fatality. The full lethal force of this outbreak is reflected more completely by the rates for deaths from all causes than by those for influenza alone; for by the rules of classification, while deaths of influenza and broncho-pneumonia are classified under influenza, those ascribed to influenza and lobar pneumonia, of which there are many, and influenza complicating such diseases as typhoid fever and whooping-cough are not. Influenza was assigned also as a contributory cause of death in a number of instances in connection with pulmonary tuberculosis, organic diseases of the heart, and other affections. There was a large number of deaths assigned to primary broncho and lobar pneumonia without influenza. It is certain that in many instances the diagnosis between broncho-pneumonia and lobar pneumonia complicating influenza was in error, and that many, if not most, of the cases diagnosed as lobar pneumonia really belonged to the former category and should in truth under the rules have been classified under influenza. As a matter of fact, there is in the light of present knowledge no adequate reason for this distinction.

Neither the reported cases nor the deaths of influenza were analyzed for distribution according to age. In regard to color and sex, the 81 deaths of influenza occurring between January 1 and September 1 were divided as follows: White, total 52, male 25, females 27; colored, total 29, male 13, female 16. The differences in the number of fatalities by sex were not great, but the

TABLE 58.—*Number of cases and deaths and morbidity and mortality rates, per 100,000 living inhabitants, from influenza and number of deaths and mortality rate from all causes, by weeks, for 1918 and 1919.*

C = cases. R = rate. D = death.

Week ending.	Influenza.		Influenza.		All causes.	
	C	R	D	R	D	R
1918						
Sept. 7	...	...	1	8	184	1330
Sept. 14	...	...	...	...	190	1374
Sept. 21	...	...	...	...	163	1179
Sept. 28	53	447	3	25	194	1403
Oct. 5	3165	26718	71	599	321	2321
Oct. 12	8945	75511	344	2904	793	5733
Oct. 19	5416	45720	614	5183	1691	12226
Oct. 26	2374	20041	327	2760	1358	9818
Nov. 2	588	4964	139	1173	613	4432
Nov. 9	75	633	39	329	314	2270
Nov. 16	116	979	14	118	234	1692
Nov. 23	60	507	4	34	238	1721
Nov. 30	94	794	12	101	212	1533
Dec. 6	164	1384	29	245	230	1663
Dec. 13	256	2161	22	186	248	1793
Dec. 20	324	2735	21	177	220	1591
Dec. 27	272	2296	17	144	235	1699
1919						
Jan. 3	294	2126	14	101	227	1641
Jan. 10	402	2907	24	174	279	2017
Jan. 17	978	7071	31	224	289	2090
Jan. 24	1445	10447	61	441	401	2899
Jan. 31	847	6124	53	383	362	2617
Feb. 7	355	2567	43	311	364	2632
Feb. 14	262	1894	42	304	313	2263
Feb. 21	199	1439	23	166	335	2422
Feb. 28	173	1251	22	159	272	1967
Mar. 7	115	831	11	80	254	1836
Mar. 14	74	535	11	80	251	1815
Mar. 21	21	152	15	108	219	1583
Mar. 28	21	152	10	72	212	1533
Apr. 4	12	87	3	22	211	1526
Apr. 11	14	101	3	22	230	1663
Apr. 18	5	36	3	22	178	1287
Apr. 25	4	29	4	29	233	1685

disease was much more fatal for negroes than for whites, the ratio of deaths being as 5 to 3, in a population with whites in the proportion of 5.75 whites to 1 negro. Of the 1,662 deaths from influenza between September 1 and December 31, there were whites, total 1,403, males 693, females 710, and negro, total 259, males 123, females 136. Here there were no significant differences in distribution either by sex or by color. The incidence of influenza

deaths in white and negro was in the proportion of about 5 to 1, in a population racially distributed in a ratio of about 5.75 to 1. So in the period of the epidemic the most usual position of whites as to fatality from influenza was largely lost. This change is clearly shown in table 59. As between the sexes there were no significant differences in the rates for white, but among negroes the rates for males were distinctly higher than those for females.

The point has been made that the influenza epidemic of 1918 was accompanied by epidemic incidence of broncho-pneumonia, and that the number of deaths credited to influenza fell far short of the true number, because, on account of the rules of classification, deaths ascribed to this disease with lobar pneumonia were classified under the latter rubric. This is fully borne out by table 59, in which it will be observed that during the period of the influenza epidemic, the monthly annual rates for both broncho-pneumonia and lobar pneumonia were not only much higher than normal, but moved synchronously with those for influenza. In both cases the rates for negroes were higher than those for whites, and with the exception of broncho-pneumonia in the negro, in whom the reverse occurred, the recorded mortality was decidedly greater among males than among females of both races.

The high fatality of the epidemic outburst was apparently due to the unusual virulence of the disease itself and to the fact that it happened to occur at a time when *Streptococcus hemolyticus* broncho-pneumonia was prevalent.

As elsewhere, the disease spread through the community like wildfire, striking down whole families, sometimes all at once, and sometimes the various individuals in succession. In the height of the outbreak physicians, depleted in numbers owing to the war, could not respond to all of their calls; the hospitals, crippled by lack of full corps of physicians, nurses, and orderlies, were unable properly to care for the crowds demanding their care, and every public and private service was seriously embarrassed.

The figure cut by the health department was distressing. In the middle of September, the writer, realizing, as must any one familiar with what is known of the natural history of influenza in general and acquainted with its recent behavior in Europe and in New England at the time, that it was hopeless to expect by the use of any known methods to prevent its entrance into the city or to stop its spread when it entered, advised the commissioner of health not to complicate the situation by fruitless attempts at interference, but to organize about the health department all the various medical, nursing, and relief agencies for the care of those who must inevitably be stricken. Finally adopting this view after ascertaining that it was acquiesced in by a number of leading physicians whom he consulted, plans were laid to organize the social forces for aid. Before anything concrete was accomplished, however, the epidemic was well under way, and at the critical time, falling under the influence of the remarkable circular letter of the Surgeon General of the United States Public Health Service, embodying recommendations of archaic type, and bowing, in the face of knowledge and common sense, to authority, the commissioner spent his energies in issuing orders which, if obeyed, would have paralyzed every activity necessary among the inhabitants of a great city in the midst of war. So far did restrictive regulations extend that for some days it was a criminal offense for a junk-dealer to sell scrap-iron. In consequence, the staff of the health department devoted its energies mainly to trying to restrict

TABLE 59.

INFLUENZA.

D = death. R = rate.

	Total.		White.						Colored.					
			Total.		Male.		Female.		Total.		Male.		Female.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1918														
Jan. ..	24	46	18	41	7	33	11	49	6	71	4	104	2	44
Feb. ..	14	30	10	25	6	30	4	20	4	53	3	86	1	24
Mar. ..	20	38	12	27	5	23	7	31	8	95	5	130	3	66
Apr. ..	12	24	7	16	3	14	4	19	5	61	....	....	5	113
May ..	6	11	4	9	3	14	1	4	2	24	1	26	1	22
June ..	2	4	1	2	1	5	....	....	1	12	....	....	1	23
July ..	1	2	....	....	....	....	....	....	1	12	....	....	1	22
Aug. ..	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Sept. ..	11	22	10	23	5	23	5	23	1	12	1	27	....	....
Oct. ..	1464	2791	1245	2826	600	2750	645	2901	219	2604	102	2650	117	2566
Nov. ..	93	183	70	164	44	208	26	121	23	283	10	268	13	295
Dec. ..	94	179	78	177	44	202	34	153	16	190	10	260	6	132
Total .	1741	282	1455	281	718	279	737	282	286	289	136	300	150	279

BRONCHO-PNEUMONIA.

1918														
Jan. ..	81	154	52	118	28	128	24	108	29	345	13	338	16	351
Feb. ..	120	253	85	214	58	294	27	134	35	461	12	345	23	559
Mar. ..	85	162	56	127	31	142	25	112	29	345	18	468	11	241
Apr. ..	86	169	53	124	28	133	25	116	33	406	12	322	21	476
May ..	50	95	34	77	18	82	16	72	16	190	8	208	8	175
June ..	29	57	24	56	9	43	15	70	5	61	3	81	2	45
July ..	24	46	13	30	9	41	4	18	11	131	4	104	7	154
Aug. ..	11	21	5	11	3	14	2	9	6	71	1	26	5	110
Sept. ..	24	47	15	35	8	38	7	33	9	111	4	107	5	113
Oct. ..	357	681	288	654	160	733	128	576	69	821	20	520	49	1075
Nov. ..	61	120	51	120	27	128	24	112	10	123	3	81	7	159
Dec. ..	66	126	53	120	32	147	21	94	13	155	4	104	9	197
Total .	994	161	729	141	411	160	318	121	265	268	102	225	163	304

LOBAR PNEUMONIA.

1918														
Jan. ..	129	246	90	204	53	243	37	166	39	464	24	623	15	329
Feb. ..	134	283	89	224	54	274	35	174	45	592	31	892	14	340
Mar. ..	138	263	71	161	42	192	29	130	67	797	42	1091	25	548
Apr. ..	90	177	64	150	35	166	29	135	26	320	17	456	9	204
May ..	36	69	19	43	12	55	7	31	17	202	12	312	5	110
June ..	25	49	15	35	9	43	6	28	10	123	5	134	5	113
July ..	13	25	9	20	5	23	4	18	4	48	1	26	3	66
Aug. ..	12	23	6	14	4	18	2	9	6	71	2	52	4	88
Sept. ..	39	77	29	68	23	109	6	28	10	123	7	188	3	68
Oct. ..	1696	3233	1409	3198	784	3593	625	2811	287	3413	155	4026	132	2895
Nov. ..	103	203	75	176	52	246	23	107	28	344	14	376	14	317
Dec. ..	118	225	92	209	54	247	38	171	26	309	16	416	10	219
Total .	2533	410	1968	379	1127	439	841	321	565	571	326	719	239	445

absolutely essential activities or in explaining to irate and embarrassed citizens how and when, if at all, they could, within the regulations, sell or buy food, clothing, and drugs, go to and from their work, or get married or buried. Not only schools, churches, and theaters, but many businesses, were practically closed. The only real service was done by the scant force of nurses in helping some of the sick, by one officer in getting a sufficient number of common coffins made to break the coffin monopoly, and by another in assigning laborers to bury the accumulated dead at cemeteries. There was no coordination of helping agencies, each of which did the best it could without special direction and assistance. In the health department chaos reigned and futile conflicting restrictive orders gushed forth in ever-increasing volume.

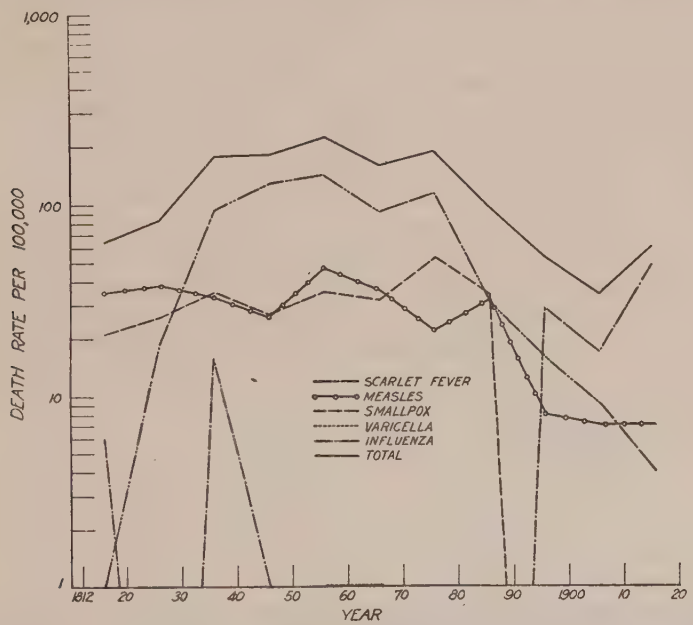
SUMMARY.

The curve for the annual mortality rates for this group of diseases as a whole (table 34, graphs 11 and 13) shows not only considerable variations from year to year, but a number of very distinct and usually sharply crested waves which extend over periods of several years.

The wide fluctuations in the total rates are caused in part by similar changes in the rates for the several members of the group and in part by the fact that the various members enter at different times and some of them, after their first entry, drop out for longer or shorter periods. For these reasons it is impracticable to represent graphically and to analyze sharply the contribution of each to the whole. The peaks of the successive waves of the total annual mortality rates tend to become higher up to 1872. After this date, with the exception of the peak of 1883, they tend to fall in an irregular manner to much lower levels until 1918, when there is a sharp reaction to a relatively high level. Years with exceptionally high rates were as follows: 1823, 272; 1834 and 1837, each, 303; 1844, 270; 1845, 296; 1848, 314; 1852, 353; 1857, 328; 1858, 434; 1862, 338; 1864, 304; 1872, 473; 1883, 305; 1918, 296. The high total rates of many of these peak years, as well as in other years, were often due to extraordinarily high rates for a single disease. With the possible exception of small-pox and varicella, the various numbers of the group developed high and low rates of mortality apparently quite independently of each other. There is no striking and constant similarity in the course of their curves as regards years of high and low rates.

From the total rate and the rates for the various diseases, as averaged for 5-year periods from 1811 to 1920 (table 43, graphs 12 and 14), a clearer idea may be gotten of the death toll of the group as a whole and the relative importance of the contributions of its various members. Beginning with a total rate of 83 in 1812–1815, there was a drop to 48 in 1815–1820, a rise to 132 in 1821–1825, and a fall to 53 in 1826–1830. Influenza in the first period and measles and small-pox during the whole time were the chief contributors. Due very largely to scarlet fever and in some degree to influenza, the total rate jumped to 202 in 1831–1835. After falling to 154 in 1836–1840, the rate rose continuously to 233 in 1856–1860. During the 30 years from 1831 to 1860, scarlet fever was by far the largest single contributor to the total rate; small-pox played, on the whole, a less important part than measles; and influenza did

not appear significantly after 1835. After a moderate decline to 215 in 1861–1865 and influenced very largely by the falling-off in the mortality from scarlet fever, the rate fell abruptly to 107 in 1866–1870. Owing particularly to decided increases in the rates for small-pox and scarlet fever, the total rate reached to 248 in 1871–1875. In association with changes in the rates for small-pox and measles, the total rate declined in 1876–1880 to 133 and in 1881–1885 reached 147. A remarkable fall in the total rate to 47 in 1886–1890 was brought about by the final disappearance of small-pox as a serious cause of death and by a distinct drop in the rate for scarlet fever. The rise of the total rate to 72 in 1891–1895 was due very largely to the reentrance of influenza, for the rise in the rate for scarlet fever was largely offset by a fall for that of measles. The descent in the total rate to 33 in 1896–1900 was associated with the



GRAPH 16 (from table 43). Crude mortality-rates from small-pox, varicella, scarlet fever, measles, and influenza, averaged by 10-year periods, from 1812 to 1920, inclusive.

decline of measles and scarlet fever to new low levels and to a considerable decrease in the rate for influenza. The total rate now stood at the lowest level ever attained in our records. Slight changes in the rates for all three contributors carried the rate for 1901–1905 up to 37, and brought it down to 31 in 1906–1910 and 27 in 1911–1915. A very considerable rise in the rate for influenza caused the total rate to reach 94 in 1916–1920. It will be observed that for the group as a whole the rates ascended in a somewhat irregular fashion until 1871–1875, and that, with this date as a turning-point, they declined by irregular steps. But for the reentrance of influenza upon the scene in 1890, this decline would have been much less irregular and much more marked, and by 1900 the rate for the whole group would have become negligible.

The curve of the total rates as averaged for 10-year periods (table 43 and graph 16) rose from 64 in 1812–1820 to the peak rate of 225 in 1851–1860.

After a drop to 161 in 1861–1870, succeeded by a rise to 191 in 1871–1880, there was a continuous decline to 34 in 1901–1910. This was followed by a reaction to 60 in 1911–1920. Thus, after 100 years, the mortality-rate for this group as a whole has returned to the same level from which it started. Measles, scarlet fever, and small-pox were the longest and most weighty contributors to the total rate, and of these scarlet fever was by far the most important. It was characterized by the highest averaged rates and determined the shape of the curve of the total rate for most of the period. Measles ran, on the whole, the more consistently even course. Of the three, small-pox fluctuated the most widely and soonest fell in importance. Influenza contributed forcibly at the beginning and end of the period, and after 1900 it determined the shape of the curve. The influence of chicken-pox was comparatively negligible throughout.

The percentage of the number of deaths from this group of diseases to the number of deaths from all causes varied considerably at different periods. Percentages as high as 11, 12, 13, 14, and 15 occurred in several years. In 1858, 16 per cent of all deaths were ascribed to these affections. After 1883, as judged by this criterion, they sank to a relatively unimportant position. During the 109 years through which their course has been traced, the members of this group of diseases have disclosed very clearly and distinctly certain important attributes which must be regarded as inherently characteristic of their natural history in a population of the size and composition of Baltimore. In the period under consideration, each except chicken-pox, which was apparently already endemically established, has repeatedly entered, attacked considerable numbers in the population, and then, certainly as causes of death and as clinically recognizable diseases, completely disappeared, often for a considerable period of years.

The disappearance of each of these diseases from the community after these epidemic outbreaks has occurred in the absence of the use of any measures or at least of reasonably adequate measures, designed to control their spread. When in this purely epidemic phase, each of these diseases has invariably run its course in from 6 to 36 months. After repeated experiences of this character, small-pox, measles, scarlet fever, and influenza, each in turn and after some particular epidemic invasion, have became endemically established, with cases and deaths each year for a number of years in succession. Finally, after becoming endemically intrenched, they have all exhibited certain common characteristics in their succeeding course. The first of these is the persistence of the epidemic qualities, as shown by exacerbations of incidence and fatality extending over several years, followed by periods of remission or depression during which incidence and fatality were much reduced. These rest periods varied in length for the different diseases and for the same disease at different times in its history. A second characteristic is the occurrence of long undulations in the morbidity and mortality curves covering periods measured by a number of years. A third characteristic, shown particularly by small-pox, measles, and scarlet fever, the diseases of greatest fatality longest endemically established, is a gradual loss of lethal force, without, in the case of measles and scarlet fever, loss of capacity to attack. Even influenza, as established endemically between 1891 and 1917, showed on the whole a distinct impairment in force of mortality. Though deaths from varicella have always been comparatively few in

number, the course of its mortality-rates indicates the same quality of diminishing lethal power. A fourth characteristic common to measles, scarlet fever, chicken-pox, and perhaps influenza during their period of endemicity is an increase in invasive capacity, or attack-rate, as they have lost in lethal force.

Among other attributes held in common, these affections have in the main the same seasonal distributions. A study of their incidence fails to disclose evidence that one exerts any exclusive influence upon another. Two or more have existed in intensive form in the community at the same time, and severe outbreaks of several have occurred in the same year.

As has been brought out in consideration of each of these diseases separately, the usual measures of a restrictive sort to prevent the spread of any of them were not undertaken until late in this history. None of them was made reportable by law until 1882, and none, except small-pox, was reported with any reasonably accurate completeness before 1897. The usual restrictive measures, including fumigation, were not begun against scarlet fever until after 1900, or against measles until after 1910—in each case long after the disease had ceased to be attended with high rates of mortality. Against influenza, sparingly reported since the fall of 1918, no measures have been attempted. Accommodations for hospitalization of more than a small percentage of patients and contacts, except for small-pox since 1885, have never been available.

The conclusion is inevitable that all of these diseases have defied all the restrictive measures, such as quarantine, isolation, and disinfection, which have been directed to control their spread, and that, as all substantial decreases in their mortality-rates occurred before such measures were seriously attempted, decline in their mortality and increase in their morbidity were altogether independent of interferences of this character. It can not be denied, however, that the application of these measures in recent times may not have often served to protect certain individuals and groups of individuals from attacks. On the other hand, it would be idle, in the face of established facts to the contrary, to claim that on the whole these methods have in any serious degree influenced the natural courses of these diseases in the community. That the course of small-pox has been modified, but not controlled, by vaccination seems certain.

In regard to the question of morbidity, as true now as when written in 1838, are the words of Dr. John H. Briscoe, consulting physician to the board of health:

> "We have had scarlet fever lingering with us, but how long it is to remain the undersigned has no speculation to offer, nor has he on the general character of epidemic, contagious, or infectious disease, more than, that small-pox will continue to recur locally as an endemic or epidemic disease until vaccination has become universal throughout the land; that scarlet fever and measles occur under no fixed laws, and both seem disposed to abide with us."

To what degrees the changes resulting in the present status of the attack and fatality rates of these diseases have resulted from modifications of the several viruses, of the population, and of the environment are matters of speculation. From the standpoint of natural selection as a possible influence, it may be significant that the highest incidence and the highest death-rates for those members of the group which have been most fatal have been among individuals too young to have had progeny. In consequence, those dying of any one of

these diseases have, in general, failed to perpetuate a specially susceptible strain, and survivors of attacks have had the advantage of transmitting to offspring their natural and acquired resistance to death from that particular disease.

For diseases the chances of general dissemination of whose viruses are dependent very largely upon the convalescent carriers—and it seems probable that all the members of this group belong to this class—it is obvious that high case-fatality rates must affect unfavorably and low fatality-rates must effect favorably, their opportunities to spread in the community. Any logically satisfactory explanation of the variation in morbidity and mortality exhibited by these diseases must account for the conditions, environmental and other, that, on the one hand, affect the aggressiveness of the organisms to attack and to kill, and, on the other hand, that raise or lower the resistance of the population. Definite data for framing such an explanation are wholly lacking.

ACUTE INFLAMMATORY AFFECTIONS OF THE RESPIRATORY TRACT.

Under this heading are grouped whooping-cough, diphtheria, and bronchitis and pneumonia. The first two have long been recognized clinically and statistically as definite specific diseases.

Whooping-cough, readily distinguished in typical cases by the characteristic cough, is hardly likely to be confused clinically to a serious degree with other affections. It has no doubt been confused in the statistical nosology, however, with its chief complications—bronchitis and pneumonia. The discovery in 1910 of *B. pertussis,* its probable causative agent, has from the practical standpoint added nothing of importance to exactness of diagnosis.

Diphtheria, on the other hand, until the discovery of its cause, *B. diphtheriæ,* in 1884, was the subject of much confusion with other acute affections of the throat, nose, and larynx. Hardly ever mistaken when in epidemic form, doubtless in isolated cases it has been confused clinically and therefore statistically with other affections. Again, on account of the not infrequent occurrence of pneumonia as a complication, it is likely that the latter has been credited with some deaths due primarily to the former. At the present day there is perhaps no other serious infectious disease whose natural history is so fully known. While other inflammatory diseases of the organs usually affected by diphtheria and whooping-cough are common enough clinically, they are, relatively speaking, rarely fatal. Thus they have not seriously affected the accuracy of the mortality figures for these two diseases. While from time to time, from the earliest years, a few deaths have been classified under such headings as inflammation of the throat or larynx, tonsillitis, and cynanche tonsillaris, they were never sufficiently numerous to warrant special consideration. One epidemic of so-called septic sore throat, due to streptococcus and spread largely by the milk of a particular dairy, occurred in December 1911, and January, February, and March 1912. According to conservative estimates, the cases must have numbered over 2,000. The deaths, as certified under a variety of headings suggested by the most prominent lesions, such as appendicitis, broncho-pneumonia, erysipelas, and peritonitis, as well as septic sore throat, numbered 28.

The two remaining members of this group have rested on less secure ground. Though possessing leading symptoms, they lack absolutely characteristic symptoms, such as the whoop of whooping-cough and the loss of voice and the peculiar interference with breathing of typical laryngeal diphtheria. Affecting organs not subject to direct inspection and requiring so often for differential diagnosis the use of methods of physical exploration acquired with relative difficulty, they were doubtless frequently mistaken or overlooked. These methods, percussion and auscultation, though perfected by Laennec early in the nineteenth century, were but slowly learned with precision and widely adopted in Baltimore. It is doubtful if, until William Power's return from Paris in 1838, there was a single adept in these methods in the city. In his short career, though he trained the talented T. H. Buckler and the band of bright students who gathered around them at the almshouse, he could not have trained any large proportion of the medical students and older practitioners of his day. As late as 1890 but a small proportion of the students at the Baltimore medical schools had the opportunity to become expert in the use of these methods. The rest picked them up as best they could. It was not until well after 1850 that any large proportion of the practitioners in Baltimore had any other means than those afforded by common clinical symptoms, such as chest pain, shortness of breath, fever, and the character of the respiration and expectoration for making differential diagnoses of the acute diseases of the bronchi, lungs, and pluræ. Hence it was that pleurisy occupied such a prominent position, that broncho-pneumonia, and probably bronchitis, was so long hid in catarrhal fever, and that bronchitis was differentiated so late. It is impossible to determine whether the terms "inflammation of the bronchi" and "inflammation of the lungs" belonged to medical nosology or were simply statistical rubrics of the health department, designed to simplify and shorten the lists of the causes of death.

Bronchitis alone is probably rarely fatal, and the great bulk of the deaths attributed to it must surely have been due to pneumonia, usually perhaps to one of the forms of broncho-pneumonia in the pathological anatomical sense.

Acute pneumonia or acute inflammation of the lungs (involving often, if not usually, the adjacent pleura) is not a single and specific disease, judged either from the standpoint of the portion or portions of the lung tissue involved or from the character of the exudations and other forms of inflammatory lesions.

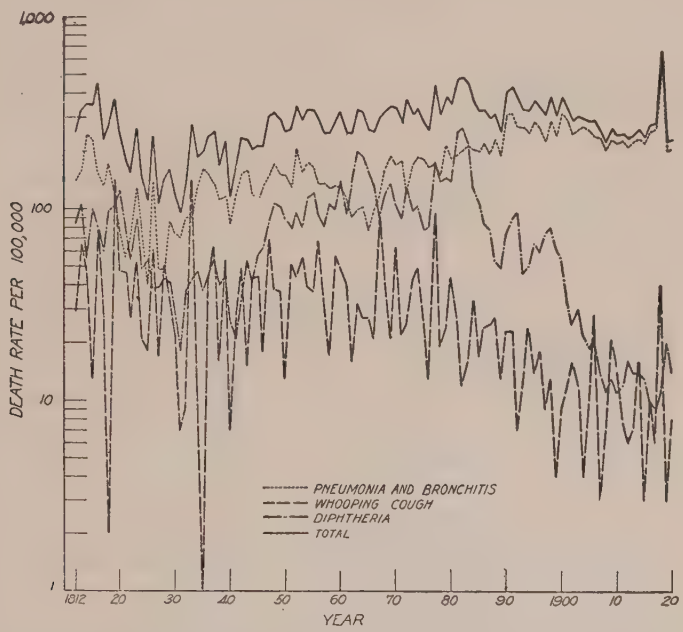
Neither bronchitis nor pneumonia in its several forms is specific in the etiological sense. Both are caused by a variety of bacteria—bacilli and cocci—and the same organism does not always give rise to the same lesions. Only one form of pneumonia, the lobar or croupous, seems to be specific in the etiological sense. It is almost if not always associated with the presence in the affected portion of the lung of a particular species of micro-organism, the pneumococcus. At least four different varieties of the pneumococcus are known, and these differ among themselves not only in frequency of ocurrence in pneumonia, but in virulence. The lethal and perhaps the invasive capacity of each type is by no means constant. Again, not only may more than one type be present in a particular case of pneumonia, but bacteria of other species as well. Lobar pneumonia, probably usually primary, occurs not infrequently as a complication of other diseases, for the most part the same as will be enumerated for broncho-pneumonia.

The peculiar type of lung infection characterized by lobar consolidation and simulating lobar pneumonia, but due to *B. mucosus,* is of too rare occurrence to be statistically important. Bronchitis and broncho-pneumonia, the latter term a gather-all for several distinct types of lesions having in common the involvment of both the bronchial and lung tissues, may be caused by a variety of cocci and bacilli. The most important of these are the streptococci, staphylococci, pneumococci, *B. mucosus,* and *B. pfiefferi* (or *B. influenzæ*). These and others may be present alone or in various combinations. While broncho-pneumonia occurs very commonly as a complication of some other disease, acute or chronic, it is not infrequently a primary disease. The most common acute diseases which it complicates are the so-called exanthematous diseases, particularly measles and influenza, whooping-cough, diphtheria, epidemic meningitis, and typhoid and typhus fevers. In many cases of wound infection, including puerpural fever, and of primary suppurative disorders, as appendicitis for instance, broncho-pneumonia is a common complication. It also occurs in such specific infections as glanders and anthrax, but usually as a part of the disease. Both broncho and lobar pneumonia occur as terminal events in the course of such chronic diseases as nephritis, arteriosclerosis, heart disease, cirrhosis of the liver, diabetes, tumor, leucæmia, and the like. In severe acute malaria pneumonia often occurred, but according to the best evidence as a complication. Finally, pathological anatomists have shown that even accomplished physicians are frequently unable to distinguish successfully between broncho-pneumonia and lobar pneumonia.

A very strong body of evidence, drawn from both clinical observation and laboratory experiment, indicates that all of these affections are in general spread by contact from person to person. Opportunity for transfer in this way is abundant, for the causative agents are present in the discharges from the air-passages and in the mouths and noses not only of their victims during illness, but often long after convalescence. The organisms of diphtheria and of lobar pneumonia have often been isolated from the mouths and throats of persons who have never been ill with these diseases. Indeed this "healthy carrier" state, common enough among those recently exposed to persons with these diseases, may occur in individuals who have never consciously been so associated. Innumerable chances occur for the transfer of the causes of all these affections by kissing, by the hands, by clothing, by utensils, and in particular by coughing. While it is doubtful if any of them are water-borne, this possibility has not been excluded. The possibility of the action of insects as mechanical carriers at certain seasons must be recognized. Milk has been shown to be an occasional vehicle of transfer for diphtheria bacilli and streptococci. All the evidence at hand tends to show that the causative agents of diphtheria, whooping-cough, and lobar pneumonia do not, under ordinary conditions at least, long survive separation from the human being as host. Streptococci, staphylococci, and *B. mucosus* are more resistant to outside influences, and in consequence have a wide range of distribution. *B. pfiefferi* does not apparently long survive separation from its favorite human habitat. These diseases must, then, be classed as contact diseases in the usually accepted sense.

WHOOPING-COUGH.

Whooping-cough appears as a cause of death in the mortality records for 1812 and is credited with deaths in each succeeding year. Endemically intrenched when the present record begins, it has maintained this position uninterruptedly. Judged from the wide fluctuations in the annual mortality-rates (table 60, graph 17), its lethal capacity in relation to the Baltimore population has been marked with great irregularity. Its highest annual death rate, 215, was in 1816, and the highest rates subsequently attained were in 1819, 1833, 1867, and 1877, 141, 140, 91, and 95, respectively. Rates between 60 and 70 occurred in 7 years (1813, 1826, 1837, 1839, 1847, 1856, and 1870), between 50 and 60



Graph 17 (from table 60). Annual crude mortality-rates from whooping-cough, diphtheria, and pneumonia, from 1812 to 1920, inclusive.

in 5 years (1823, 1828, 1851, 1853, and 1859), and between 40 and 50 in 15 years (1814, 1820, 1821, 1836, 1842, 1844, 1845, 1852, 1860, 1861, 1868, 1873, 1874, 1880, and 1918).

Very characteristic of its course has been the occurrence of unusually high death-rates for 2 or 3 years in sequence, followed by intermediate periods of low rates covering one or even several years. These short outbreaks do not, however, follow any constant law. After an exceptionally high outbreak in one year, particularly if it be preceded by a year or two of low rates, the succeeding drop is apt to be correspondingly low. This is well illustrated in 1816, 1833, 1905, and 1918. The course of the curve is, therefore, very irregular, and only rarely, as in 1843–1844, 1851–1855, 1858–1861, 1881–1883, and 1890–1891, does the disease exhibit a tendency to stabilize about a fixed level. A marked

TABLE 60.—*Number of deaths and rate of death, per 100,000 living inhabitants, from whooping-cough, diphtheria, pneumonia, bronchitis, and total acute diseases of the respiratory tract, and percentage of total deaths, from 1812 to 1920, inclusive.*

Year.	Grand total.		Percent of total deaths.	Whooping-cough.		Diphtheria.		Pneumonia and bronchitis.																							
								Total pneumonia and bronchitis.		Pneumonia.										Bronchitis.											
										Total pneumonia.		Pleurisy.		Inflammation of lungs.		Catarrhal fever.		Pneumonia.		Broncho-pneumonia.		Total bronchitis.		Total acute bronchitis.		Bronchitis.		Inflammation of bronchi.		Capillarybronchitis.		Acute bronchitis.		Chronic bronchitis.	
	D	R		D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1812	103	252	9	12	29	34	83	57	139	57	139	57	139	...	...	...	...	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1813	140	327	12	28	65	45	105	67	157	67	157	67	157	...	...	...	...	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1814	156	349	14	21	47	25	56	110	246	110	246	110	246	...	...	...	...	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1815	161	345	12	6	13	47	101	108	231	108	231	108	231	...	...	...	...	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1816	219	449	17	105	215	39	80	75	154	75	154	75	154	...	...	...	...	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1817	116	228	9	14	27	35	69	67	131	67	131	67	131	...	...	...	...	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1818	145	273	8	1	2	52	98	92	173	92	173	63	118	29	55	...	...	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1819	205	369	9	78	141	57	103	70	126	70	126	41	74	29	52	...	...	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1820	145	251	10	27	47	73	126	45	78	45	78	42	73	3	5	...	...	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1821	109	181	6	28	46	48	80	33	55	33	55	30	50	...	...	...	...	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1822	97	154	4	17	27	34	54	46	73	46	73	32	51	6	10	...	...	3	5	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1823	170	260	9	34	52	52	79	84	128	84	128	34	52	1	2	18	28	8	13	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1824	102	150	7	14	21	33	48	55	81	55	81	32	47	2	3	19	28	31	47	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1825	78	110	5	13	18	37	54	28	40	28	40	26	37	2	3	...	...	2	3	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1826	174	236	10	45	61	28	38	101	137	101	137	36	49	5	7	60	81	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1827	80	104	6	13	17	30	39	37	48	37	48	20	26	2	3	15	20	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1828	112	141	7	40	50	34	43	38	48	38	48	5	6	7	9	26	33	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1829	132	160	8	27	33	34	41	71	86	71	86	29	35	17	21	25	30	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1830	101	118	5	19	22	19	22	63	74	63	74	22	26	7	8	34	40	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1831	84	95	4	6	7	16	18	62	70	62	70	29	33	9	10	24	27	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1832	125	136	4	8	9	34	37	83	90	83	90	36	39	7	8	40	43	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1833	261	273	11	134	140	41	43	86	90	86	90	29	30	4	4	53	56	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1834	184	186	7	12	12	46	47	126	127	126	127	36	30	16	16	74	75	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1835	203	198	11	1	1	38	37	164	160	164	160	68	66	20	20	76	74	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1836	249	235	11	43	41	47	44	159	150	159	150	74	70	8	8	77	73	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1837	276	252	11	69	63	59	54	148	135	148	135	66	60	8	7	74	68	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1838	189	167	8	18	16	45	40	126	111	126	111	50	44	9	8	67	59	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1839	261	223	12	75	64	51	44	135	115	135	115	55	47	10	9	70	60	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1840	140	116	7	9	7	31	26	100	83	100	83	47	39	9	7	44	36	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1841	210	168	9	35	28	26	21	149	119	144	115	38	30	7	6	99	79	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1842	302	234	12	63	49	42	33	197	153	193	150	66	51	10	8	117	91	.....	.....	.....	.....	5	4	...	...	5	4	...	...	...	...	...	...
1843	303	228	13	20	15	71	53	212	159	212	159	87	65	14	11	110	83	1	1	.....	.....	4	3	...	...	4	3	...	...	...	...	...	...
1844	279	203	10	59	43	56	41	164	119	158	115	62	45	21	15	75	55	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	...
1845	298	211	10	62	44	80	57	156	110	151	107	49	35	11	8	89	63	2	1	.....	.....	6	4	...	...	6	4	...	...	...	...	...	...
1846	306	210	10	26	18	91	62	189	130	178	122	65	45	8	5	104	71	1	1	.....	.....	5	4	...	...	5	4	...	...	...	...	...	...
1847	458	305	13	104	69	131	87	223	148	215	143	32	21	20	13	132	88	31	21	.....	.....	11	8	...	...	11	8	...	...	...	...	...	...
1848	488	315	13	59	38	166	107	263	170	255	165	50	32	22	14	144	93	39	25	.....	.....	8	5	...	...	8	5	...	...	...	...	...	...
1849	463	291	11	59	37	164	103	240	151	233	146	69	43	32	20	126	79	6	4	.....	...	8	5	...	...	8	5	...	...	...	...	...	...
1850	413	252	10	22	13	146	89	245	149	234	143	64	39	38	23	121	74	11	7	.....	...	7	4	...	...	7	4	...	...	...	...	...	...
1851	438	260	11	86	51	134	79	218	129	200	119	44	26	55	33	101	60	.....	.....	.....	.....	11	7	...	...	11	7	...	...	...	...	...	...
1852	598	345	12	77	44	164	95	357	206	327	189	63	36	120	69	144	83	.....	.....	.....	.....	18	11	...	...	18	11	...	...	...	...	...	...
1853	515	289	11	100	56	143	80	272	153	252	141	50	28	123	69	79	44	.....	.....	.....	.....	30	17	...	...	30	17	...	...	...	...	...	...
1854	600	327	11	72	39	210	115	318	174	308	168	69	38	148	81	91	50	.....	.....	.....	.....	20	11	...	...	20	11	...	...	...	...	...	...
1855	609	324	12	69	37	229	122	311	165	311	165	45	24	124	66	142	75	.....	.....	.....	.....	10	5	...	...	10	5	...	...	...	...	...	...
1856	574	297	11	131	68	180	93	263	136	258	133	47	24	58	30	153	79	.....	.....	.....	.....	5	3	...	...	5	3	...	...	...	...	...	...

| | | |

decline in the mortality-rates began about 1880, but the persistence of considerable annual fluctuations continued.

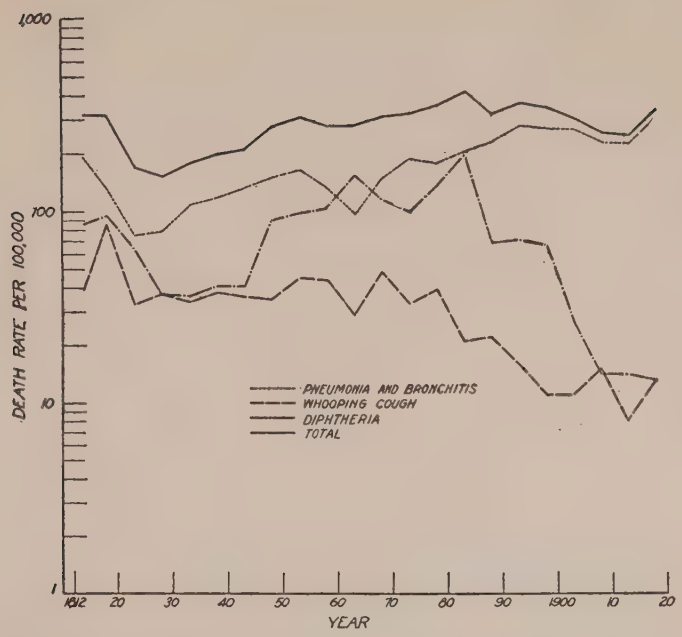
The curve of the death-rates averaged for 5-year periods (table 61, graph 18) shows a marked rise from a comparatively low rate in 1812–1815 to a rate of 86 in 1816–1820, with a sharp fall to 33 in 1821–1825. For the next 25 years the averaged rates change but little, but from 1851 to 1860 they spring to about 45, followed, however, in 1861–1865, by a sharp fall to 29. Another rise in 1866–1870 is followed by a decline in 1871–1875 and another rise in 1876–1880. From the latter date, except for a slight ascent in 1886–1890, the descent in the rates is sharp to the low rate of 11 in 1896–1900. During the last 20

TABLE 61.—*Average rate of death by 5- and 10-year periods from acute diseases of the respiratory tract, from 1812 to 1920, inclusive:*

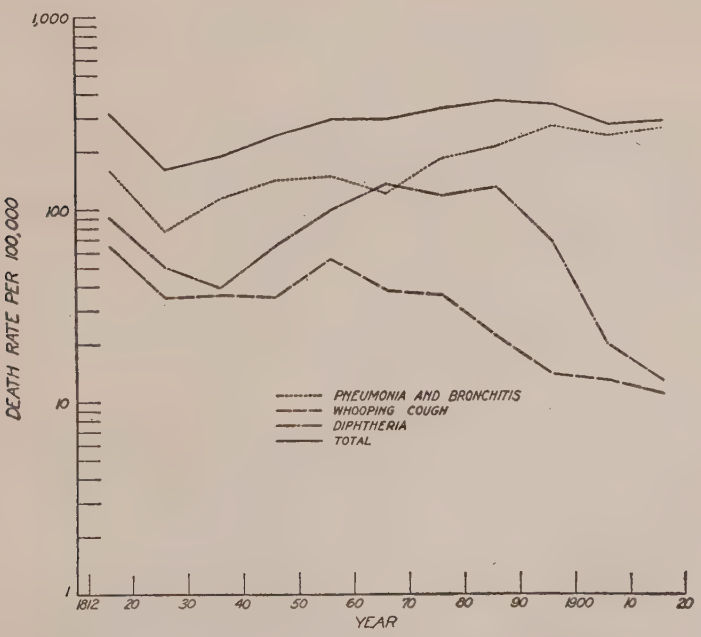
Period.	Pneumonia and bronchitis.		Whooping-cough.		Diphtheria.		Total.	
	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.
1812-15	193	...	39	...	86	...	318	...
1816-20	132	159	86	65	95	91	314	316
1821-25	75	...	33	...	63	...	171	...
1826-30	79	77	37	35	37	50	152	162
1831-35	108	...	34	...	36	...	178	...
1836-40	119	113	38	36	41	39	198	188
1841-45	132	...	36	...	41	...	209	...
1846-50	150	141	35	35	90	65	275	242
1851-55	165	...	45	...	98	...	309	...
1856-60	132	149	44	45	104	101	280	294
1861-65	97	...	29	...	156	...	281	...
1866-70	147	122	48	38	116	136	310	296
1871-75	188	...	33	...	99	...	320	...
1876-80	178	183	39	36	136	117	352	336
1881-85	203	...	21	...	195	...	418	...
1886-90	229	216	22	22	67	131	319	368
1891-95	277	...	16	...	70	...	363	...
1896-1900	267	272	11	14	66	68	343	353
1901-05	263	...	11	...	26	...	300	...
1906-10	224	243	15	13	14	20	253	276
1911-15	222	...	8	...	14	...	244	...
1916-20	305	264	13	11	13	13	332	288

years the rate has fluctuated between 8 and 15. When the rates (table 61 and graph 19) are averaged for 10-year periods, some of the irregularities above noted are eliminated and the course of the curve is somewhat modified. Starting in 1812–1820, from the high average rate of 65, there is an abrupt drop in 1821–1830 to 35, an average rate about maintained the next 20 years. From the average rate of 45 attained in 1851–1860, there is a gradual decline to 36 in 1871–1880 and a sharp decline to 14 in 1891–1900, and by 1911–1920, the average rate was 11.

These curves, obtained by averaging the annual death-rates by 5- and 10-year periods, give essentially the same picture of the course of the force of mortality of whooping-cough in Baltimore during a period of 109 years. Until 1825,



GRAPH 18 (from table 61). Crude mortality-rates from whooping-cough, diphtheria, and pneumonia, averaged by 5-year periods, from 1812 to 1920, inclusive.



GRAPH 19 (from table 61). Crude mortality-rates from whooping-cough, diphtheria, and pneumonia, averaged by 10-year periods, from 1812 to 1920, inclusive.

perhaps relatively new to the population, this disease possessed a lethal capacity of a high order, and then for 25 years became stabilized at a much lower mortality-rate. From 1850 to 1870 this level was overshot, but, by 1875, it was again reached. Since the latter date the average rate has sunk by gradations to a level lower by six times that of the nine years 1812–1820.

The influence of color, sex, and age upon the lethal force of whooping-cough in 1910 and 1920 is illustrated in tables 62 and 63. From these it is clear that the disease is over four times as fatal for negroes as for whites, taking the two

TABLE 62.—*Number of deaths and the rate of death, per 100,000 living inhabitants, from whooping-cough and diphtheria, according to age, color, and sex, for 1910.*

WHOOPING-COUGH.

D = death. R = rate.

Age-period.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
Under 1 year.....	43	420	30	337	18	401	12	273	13	964	8	1168	5	754
Between 1 and 2 yrs.	15	156	9	106	1	23	8	195	6	532	4	718	2	351
2 to 4 years.....	20	62	7	25	1	7	6	43	13	313	4	199	9	420
5 to 9 years.....	4	8	1	2	1	5	...	...	3	47	2	65	1	30
Under 10 years.....	82	81	47	53	21	47	26	59	35	268	18	285	17	252
10 to 19 years.....	1	1	...	...	...	...	...	...	1	7	1	17	...	...
20 to 29 years.....	...	...	...	...	...	...	...	...	...	...	...	....	...	...
30 to 39 years.....	...	...	...	...	...	...	...	...	...	...	...	....	...	...
40 years and over...	...	...	...	...	...	...	...	...	...	...	...	....	...	...
Total	83	15	47	10	21	9	26	11	36	42	19	48	17	37

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Under 1 year.....	4	39	3	34	2	45	1	23	1	74	1	146	...	...
Between 1 and 2 yrs.	13	135	12	141	7	160	5	122	1	89	...	....	1	175
2 to 4 years.....	31	96	31	111	19	135	12	86	...	...	...	....	...	...
5 to 9 years.....	11	22	11	25	3	14	8	37	...	...	...	....	...	...
Under 10 years.....	59	58	57	64	31	69	26	59	2	15	1	16	1	15
10 to 19 years.....	1	1	1	1	...	...	1	2	...	...	...	....	...	...
20 to 29 years.....	1	1	...	...	...	...	...	...	1	5	1	11	...	...
30 to 39 years.....	3	3	1	1	1	3	...	...	2	13	1	13	1	12
40 years and over...	...	...	...	...	...	...	...	...	...	...	...	....	...	...
Total	64	11	59	12	32	14	27	11	5	6	3	8	2	4

years together, somewhat more fatal for white males than for white females, and about equally fatal for males and females among negroes. The effect of age is striking. There was but 1 death in individuals over the tenth year of age, and nearly the whole mortality was confined to the age period 0 to 4 years, and over half of it to the first year of life. The experience of these two years in regard to the greater mortality in negroes as compared with whites is confirmed by that of the 16-year period, 1905–1920, when, of the 1,058 deaths attributed to whooping-cough, 598 were in whites and 460 were in negroes, a ratio of 1.3 to 1, while the proportion of whites to negroes in the population was 5.42 to 1.

On the assumption that throughout the course of the disease in Baltimore the fatality in whooping-cough has been largely if not entirely restricted to the population in age-group 0–9 years, mortality rates calculated on this basis for the census years 1830 to 1920, inclusive, should be instructive. These are given in table 64. It is obvious that in a disease whose fatality has varied so greatly from year to year, the rates thus obtained for these particular years, even though based upon the averages of several years, can not be taken as fully representative of the respective periods in which they lie. But, considered

TABLE 63.—*Number of deaths and rate of death, per 100,000 living inhabitants, from whooping-cough and diphtheria, according to age, color, and sex, for 1920.*

WHOOPING-COUGH.

D = death. R = rate.

Age-groups.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
Under 1 year	34	229	18	140	9	136	9	143	16	813	6	627	10	989
1 to 4 years	20	37	13	27	8	33	5	21	7	109	3	96	4	121
0 to 4 years	54	78	31	51	17	55	14	32	23	275	9	221	14	325
5 to 9 years	2	3	1	2	1	3	...	...	1	12	...	...	1	24
0 to 9 years	56	42	32	27	18	30	14	24	24	146	9	113	15	176
10 to 19 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
20 to 29 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
30 to 39 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
40 years and over	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	56	8	32	5	18	6	14	4	24	22	9	17	15	27

DIPHTHERIA.

Under 1 year	10	67	10	78	5	76	5	80	...	...	...	...	...	...
1 to 4 years	72	132	68	141	30	124	38	159	4	62	3	96	1	30
0 to 4 years	82	118	78	128	35	114	43	99	4	48	3	74	1	23
5 to 9 years	15	23	15	27	9	31	6	22	...	...	...	...	...	...
0 to 9 years	97	72	83	71	44	74	49	84	4	24	3	38	1	12
10 to 19 years	...	...	...	...	...	...	...	...	...	...	...	...	...	...
20 to 29 years	2	1	2	2	...	...	2	3	...	...	...	...	...	...
30 to 39 years	1	1	1	1	1	2	...	...	...	...	...	...	...	...
40 years and over	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	100	14	96	15	45	14	51	16	4	4	3	6	1	2

broadly, these rates bring out more clearly the relatively high mortality that obtained in the sixth, seventh, eighth, and ninth decennia of the nineteenth century, the subsequent decline from this high level, and above all the fact that to estimate correctly the real meaning of the changes observed afterward in the course of the crude rates, corrections must be made for differences which have taken place in the age distribution of the population. When this allowance is made, it is found that the force of mortality of this disease, after a high accession in the intermediate period, declined by 1890 to about the level of 1830, from which it has departed significantly only in the last 10 years.

Data for morbidity by months and years are available since 1897, and are presented in table 65. All the evidence at hand indicates that case reporting has never approached completeness. The testimony of health wardens of long experience is that many cases are never seen by physicians and that a physician called to see the first case in a family of children often does not see and report the secondary cases. Cases are never reported by parents directly. It is believed that case reporting since 1910 has reflected the actual incidence of the disease much more accurately than before that date. There is no evidence, that reporting was more accurate between 1916 and 1920 than it was between 1911 and 1915. Though in no year since 1897 do the recorded figures represent actual occurrences, relatively, they are of some importance for determining variations in incidence by months and by years. In the 24 years under review, the

TABLE 64.—*Number of deaths and the rate of death, per 100,000 living inhabitants under 10 years of age, from whooping-cough and diphtheria, for the decennia 1830 to 1920, inclusive.**

Year.	Whooping-cough.		Diphtheria.	
	Deaths.	Rate.	Deaths.	Rate.
1830	17	82	23	111
1840	39	146	36	135
1850	55	123	148	332
1860	106	189	238	424
1870	96	147	273	419
1880	107	144	611	812
1890	88	96	307	336
1900	43	42	253	249
1910	86	85	69	68
1920	40	30	123	92

* The number of deaths for each decennium is a 3-year average of that obtaining in the decennial year and in those years immediately preceding and following, except in 1920, when the average is for 1919 and 1920 only.

rates of incidence have varied considerably from year to year and have shown a wide margin between the highest and the lowest levels attained. Conspicuous examples of such deviations in the rates were, in the earlier period, 15 in 1904 and 120 in 1909, and in the later period, 42 in 1915 and 508 in 1920. The rates averaged for 5-year periods were 46 and 47, respectively, for 1897–1900 and 1901–1905, 75 for 1906–1910, 62 for 1911–1915, and 237 for 1916–1920. The annual rates averaged for the 10-year periods 1901–1910 and 1911–1920 were 61 and 149, respectively. The increase in recorded incidence of the disease since 1916 is particularly striking. It will be noted that after two years of exceptionally high rates, 230 and 209, respectively, the former the highest ever recorded up to that time, the rate in 1918 jumped to 508. Falling to 91 in 1919, the morbidity-rate rose to 148 in 1920. While the general increase in the morbidity-rates since 1910 was doubtless in some measure due to more complete case reporting in this period as compared with the years previous to this date, the wide annual fluctuations characteristic of both periods can not be

TABLE 65.—*Morbidity by months and years and monthly annual and annual rates of morbidity, per 100,000 living inhabitants, from whooping-cough, from 1897 to 1920, inclusive.*

C = cases. R = rate.

Year.	Jan.		Feb.		March.		April.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total.			Percentage case fatality.	
	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	Average rate of morbidity by 5-year periods.	Annual.	Average by 5-year periods.
1897	22	53	12	32	3	7	16	40	7	17	21	53	17	41	16	39	13	33	17	41	32	80	37	90	213	44	.....	19.72	.....
1898	67	160	70	185	54	129	35	86	31	74	19	47	19	45	19	45	9	22	1	2	8	20	3	7	335	68	.....	19.10	.....
1899	6	14	7	18	3	7	9	22	5	12	7	17	26	61	11	26	16	39	3	7	20	49	7	16	120	24	.....	15.83	.....
1900	16	37	33	85	19	44	22	53	23	53	32	77	17	39	32	74	22	53	8	19	9	22	6	14	239	47	46	19.67	18.58
1901	7	16	19	48	11	25	29	69	24	55	25	59	11	25	40	92	30	71	29	66	13	31	19	44	257	50	.....	24.51	.....
1902	35	79	14	35	37	84	63	147	41	93	58	136	39	88	44	99	18	42	12	27	18	42	16	36	395	76	.....	21.27	.....
1903	28	63	15	37	16	36	12	28	3	7	14	32	24	54	28	63	27	62	25	56	29	67	12	27	233	44	.....	27.47	.....
1904	17	37	12	29	10	22	11	25	10	22	3	7	1	2	5	11	6	14	...	...	1	2	2	4	78	15	.....	30.77	.....
1905	4	9	...	...	1	2	7	16	60	131	43	97	28	61	17	37	21	47	23	50	24	54	43	94	271	50	47	23.62	25.53
1906	104	224	95	226	73	157	45	100	39	84	39	87	18	39	9	19	8	18	23	49	11	24	1	2	465	85	.....	32.47	.....
1907	8	17	11	26	8	17	6	13	2	4	2	4	6	13	9	19	21	46	13	28	4	9	27	57	117	21	.....	14.53	.....
1908	16	34	26	61	27	57	18	39	33	69	23	50	31	65	33	69	12	26	5	11	10	22	4	8	238	43	.....	17.23	.....
1909	17	35	12	28	24	50	86	185	62	129	75	161	110	229	111	231	45	97	38	79	47	101	58	121	685	121	.....	17.08	.....
1910	96	198	106	241	102	210	72	153	27	56	92	196	29	60	19	39	22	47	17	35	20	43	4	8	606	106	75	13.70	19.00
1911	31	63	23	52	53	108	35	74	35	71	17	36	28	57	24	49	15	32	14	29	23	48	45	92	343	59	.....	13.99	.....
1912	50	101	61	136	51	103	32	67	40	81	31	65	45	91	44	89	13	27	14	28	15	31	12	24	408	70	.....	8.09	.....
1913	17	34	14	31	20	40	43	89	18	36	30	62	43	86	16	32	13	27	21	42	26	54	29	58	290	49	.....	14.14	.....
1914	58	115	73	160	62	123	63	129	97	192	60	123	48	95	27	53	7	14	11	22	8	16	8	16	522	88	.....	17.82	.....
1915	29	57	13	28	14	27	29	59	8	16	7	14	6	12	15	29	25	51	32	63	34	69	38	74	250	42	62	8.40	12.49
1916	76	147	145	311	196	380	153	307	161	312	203	407	185	359	154	299	57	114	38	74	15	30	13	25	1396	230	.....	4.51	.....
1917	11	21	10	21	22	42	52	103	69	133	104	207	233	448	208	400	126	250	110	212	167	332	161	310	1273	208	.....	2.99	.....
1918	297	566	342	722	409	780	316	622	442	843	426	839	477	852	245	467	99	195	42	80	25	49	17	32	3137	508	.....	7.81	.....
1919	19	31	22	40	31	51	47	79	38	62	79	133	146	238	76	124	46	78	51	83	32	54	67	109	654	91	.....	3.52	.....
1920	76	122	78	139	65	104	75	124	67	108	86	143	114	183	106	170	88	146	90	144	115	191	125	201	1085	148	237	5.16	4.80

so explained. Whatever the actual and the relative values of the rates previous to 1910, the evidence at hand indicates that at least the major part of the increase in the rates between 1916 and 1920, as compared with the period 1911–1915, was due to a real rise in incidence, and not alone to fuller case reporting.

TABLE 66.—*Number of cases and the rate of morbidity, per 100,000 living inhabitants in 1920, for whooping-cough and diphtheria, according to age, sex, and color, for 1921.*

WHOOPING COUGH.

C = cases. R = rate.

Age-groups.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	C	R	C	R	C	R	C	R	C	R	C	R	C	R
Under 1 year.	396	2666	349	2709	196	2970	153	2435	47	2388	22	2299	25	2473
1 to 4 years	1444	2649	1381	2871	669	2771	712	2973	63	983	28	899	35	1063
0 to 4 years	1840	2653	1730	2837	865	2813	865	1996	110	1313	50	1229	60	1394
5 to 9 years	1265	1961	1205	2136	589	2061	616	2213	60	744	25	648	35	832
0 to 9 years	3105	2320	2935	2500	1454	2451	1481	2560	170	1034	75	946	95	1116
10 to 19 years	142	115	126	117	63	119	63	115	16	100	8	113	8	90
20 to 29 years	8	6	8	7	....	....	8	13	....	....	....	....	....	....
30 to 39 years	12	10	12	12	6	12	6	12	....	....	....	....	....	....
40 to 49 years	2	2	2	3	1	3	1	3	....	....	....	....	....	....
50 to 59 years	....	....	....	....	....	....	....	....	....	....	....	....	....	....
60 to 69 years	....	....	....	....	....	....	....	....	....	....	....	....	....	....
70 to 79 years	2	13	2	15	....	....	2	27	....	....	....	....	....	....
80 years and over	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Total ...	3271	446	3085	493	1524	494	1561	493	186	171	83	156	103	186

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Under 1 year.	48	323	38	295	21	318	17	271	10	508	2	209	8	791
1 to 4 years	554	1016	537	1116	291	1205	246	1027	17	265	13	418	4	121
0 to 4 years	602	868	575	943	312	1015	263	607	27	322	15	369	12	279
5 to 9 years	508	788	493	874	266	931	227	815	15	186	10	259	5	119
0 to 9 years	1110	8293	1068	910	578	974	490	844	42	255	25	315	17	200
10 to 19 years	185	150	174	161	84	159	90	164	11	69	5	71	6	68
20 to 29 years	75	52	72	60	23	39	49	81	3	11	....	....	3	22
30 to 39 years	38	31	36	36	9	18	27	54	2	9	....	....	2	19
40 to 49 years	8	9	8	10	3	8	5	13	....	....	....	....	....	....
50 to 59 years	5	8	5	9	1	4	4	14	....	....	....	....	....	....
60 to 69 years	1	3	1	3	....	....	1	6	....	....	....	....	....	....
70 to 79 years	1	7	1	8	1	18	....	....	....	....	....	....	....	....
80 years and over	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Total ...	1423	194	1365	218	699	227	666	210	58	53	30	56	28	50

From table 66 it appears that, so far as may be judged from the reported cases in 1921, the incidence of whooping-cough was confined almost entirely to individuals under the tenth year. The attack-rate was notably high under 1 year of age, and higher in the first than in the second 5 years of life. Morbidity was much greater among whites than among negroes, and somewhat greater among females than among males in the black race.

Rates for case fatality are, of course, open to the same criticism as those for morbidity. Extreme examples of these variations are 3 per cent in 1919 and 32 per cent in 1906. They have by no means risen and fallen directly with the morbidity-rates, for whereas, lower case-fatality rates have often synchronized with higher morbidity-rates, the reverse has also frequently occurred (table 65). As averaged for 5-year periods from 1901 to 1920, the case-fatality rates were 26, 19, 13, and 5 per cent, respectively. Has whooping-cough in the last 15 years, as the official figures seem to show, become more prevalent and relatively less lethal, or, otherwise expressed, has a greater increase in invasive capacity been associated with a corresponding decrease in mortality force? It has been shown that differences in accuracy of case reporting can not be held responsible for all of the variations in morbidity. There were no marked differences in the age, sex, and race distributions of the population. Light may be thrown upon this point by the experience of earlier years. From 1812 to 1815 there were 67 deaths recorded from whooping cough in an average population of about 45,000, and on a basis of a case-fatality rate of 5 per cent (as apparently obtained on an average between 1916 and 1920) there would have been 1,340 cases, a total case incidence of about 3,000 per 100,000, or an average of 750 per 100,000 per annum. But in a single year, 1816, immediately following this period, there were 105 deaths in a population of about 48,000, which on the same ratio would mean 2,100 cases, or an incidence rate of 4,375 per 100,000. Accordingly, in the 5 years there would have been 3,440 cases, a number equal to at least a fourth of the number of living children under 10 years of age in the population. Therefore, unless the disease was much more common in the higher ages than has recently obtained, no such attack-rate would have been likely. On the whole, therefore, it would appear that during the 20-year period 1901–1920 the morbidity-rates were constantly rising and the case-fatality rates were falling.

From the curves of the monthly annual mortality and morbidity rates (tables 65 and 67) it is evident that whooping-cough has, as a general rule, increased in both mortality and in incidence in spring and early summer months and often reaching, or at least maintaining, the highest levels in midsummer. The lowest rates have very commonly fallen in the late summer and fall. Months in which the maximum mortality has occurred during the 65 years, 1856–1920, inclusive, as expressed in percentages of the total number of years (table 68) were, August 23, July 17, September 14, January 9, February and June, each, 8, March 6, April and October, each, 5, November 3, and May and December, each, 2. Months of highest incidence, for the 24 years 1897–1920, inclusive, similarly expressed (table 68), were, February 25, December and July, each, 17, April, May, and August, each, 8, January, March, June, and November, each, 4. On the same basis of calculation, months of lowest incidence were, December 29, February and October, each, 17, March 13, May and September, each, 8, January and July, each, 4. In no years did the highest incidence fall in September or October, or the lowest incidence occur in April, June, August, or November.

With the exception of such exclusion from school of children with whooping-cough as may have been exercised by the school authorities, no administrative measures were applied to restrict the spread of whooping-cough until 1916.

TABLE 67.—*Mortality by months and years and monthly annual and annual mortality rates, per 100,000 living inhabitants, from whooping-cough, from 1856 to 1920, inclusive.*

D = death. R = rate.

Year.	Jan.		Feb.		Mar.		Apr.		May		June		July		Aug.		Sept.		Oct.		Nov.		Dec.		Total.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1856	11	67	2	13	9	55	5	31	5	30	12	76	20	122	18	110	22	138	15	91	5	31	7	43	131	68
1857	8	47	7	46	6	36	4	25	4	24	2	12	1	6	10	59	4	25	6	36	5	31	2	12	59	30
1858	1	6	3	19	1	6	...	...	3	17	3	18	3	17	6	35	4	24	6	35	2	12	2	12	34	17
1859	6	34	1	6	11	62	4	23	5	28	10	58	13	73	25	141	20	116	11	62	5	29	9	51	120	57
1860	7	38	8	49	7	38	10	57	8	44	7	40	10	55	7	38	12	68	18	99	4	23	8	44	106	49
1861	7	37	6	36	14	75	11	61	9	48	1	6	4	21	11	59	10	55	3	16	4	22	11	59	91	41
1862	5	26	3	17	2	10	4	22	4	21	3	16	3	16	3	16	1	5	4	21	2	11	3	16	37	16
1863	1	5	1	6	4	20	...	...	4	20	6	32	4	20	7	36	16	84	11	56	14	74	5	25	73	32
1864	3	15	4	22	3	15	7	36	7	35	4	21	8	40	9	45	9	46	4	20	...	...	7	35	65	27
1865	6	29	5	27	9	44	5	25	5	24	1	5	7	34	3	15	4	20	10	49	4	20	6	29	65	27
1866	2	9	1	5	4	19	8	39	7	33	6	29	4	19	5	24	5	24	4	19	3	15	3	14	52	27
1867	22	102	14	72	13	60	30	143	16	74	6	29	8	37	9	42	15	72	30	139	34	163	34	157	231	91
1868	8	36	6	30	4	18	11	51	9	41	5	23	7	32	18	81	16	75	8	36	13	61	5	23	110	42
1869	8	35	2	10	8	35	4	18	2	9	2	9	5	22	4	18	4	18	5	22	7	32	4	18	55	21
1870	5	22	3	14	6	26	8	36	17	73	19	85	26	112	45	194	18	80	9	39	8	36	9	39	173	63
1871	7	30	10	47	5	21	7	31	7	30	1	4	4	17	3	13	1	4	6	25	4	17	6	25	61	22
1872	3	12	2	9	3	12	8	34	1	4	5	21	8	33	12	50	8	34	6	25	3	13	11	45	70	25
1873	7	28	5	22	8	32	10	42	6	24	12	50	20	81	15	61	15	63	12	48	4	17	8	32	122	42
1874	5	20	11	48	10	39	12	49	6	24	12	49	13	51	25	99	17	69	12	47	14	57	9	36	146	49
1875	6	23	17	73	12	46	8	32	9	38	8	32	7	27	5	19	2	8	3	12	...	...	1	4	78	26
1876	2	8	2	8	3	11	2	8	5	19	...	...	1	4	7	26	8	31	2	8	5	20	2	8	39	13
1877	11	41	6	25	21	78	28	107	26	96	56	214	53	196	51	189	29	111	9	33	8	31	5	19	303	95
1878	3	11	4	16	7	25	2	7	5	18	5	19	6	22	17	62	1	4	8	29	...	...	5	18	63	19
1879	3	11	6	24	5	18	5	18	2	7	4	15	10	36	10	36	13	48	10	36	5	18	7	25	80	24
1880	5	17	6	23	4	14	4	14	15	52	13	47	17	59	21	73	19	68	22	77	9	32	13	45	148	44
1881	5	17	11	41	4	14	7	25	1	3	8	28	10	34	13	44	14	49	8	27	6	21	6	20	93	27
1882	4	13	4	15	3	10	3	10	3	10	5	17	7	23	3	10	5	17	2	7	1	3	3	10	43	12
1883	3	10	1	4	5	16	1	3	2	7	5	17	4	13	7	23	5	17	4	13	7	24	15	49	59	16

1884	10	32	4	14	10	32	9	30	15	48	7	23	16	51	18	58	9	30	10	32	7	23	5	16	120	33
1885	5	16	1	3	...	...	4	13	5	16	3	10	8	25	12	38	11	36	4	13	4	13	6	19	63	17
1886	7	22	6	20	7	22	1	3	12	37	10	32	13	40	8	25	12	38	12	37	2	6	1	3	91	24
1887	4	12	2	7	3	9	12	38	5	15	8	25	11	33	17	51	13	41	9	27	7	22	7	21	98	25
1888	7	20	13	40	18	51	11	32	5	14	2	6	11	31	10	28	9	26	11	31	10	29	5	14	112	27
1889	10	28	5	15	4	11	5	14	...	...	4	11	4	11	4	11	2	6	2	6	4	11	10	28	54	13
1890	4	11	6	18	10	27	6	17	1	3	6	17	12	33	17	46	17	48	11	30	4	11	6	16	100	23
1891	15	40	12	35	10	27	8	22	14	37	8	22	8	21	10	27	8	22	3	8	4	11	3	8	103	23
1892	4	10	3	9	3	8	1	3	1	3	1	3	6	16	2	5	2	5	5	13	2	5	2	5	32	7
1893	2	5	8	23	7	18	4	11	6	15	6	16	15	39	3	8	3	8	1	3	3	8	2	5	60	13
1894	5	13	1	3	7	18	4	10	10	25	20	52	17	43	13	33	20	52	3	8	4	10	8	20	112	24
1895	5	12	11	30	6	15	6	15	2	5	2	5	11	27	5	12	8	21	10	25	...	...	2	5	68	14
1896	5	12	7	19	10	25	5	13	7	17	7	18	16	39	9	22	4	10	12	30	...	...	5	12	87	18
1897	4	10	1	3	...	...	2	5	6	15	9	23	5	12	3	7	2	5	3	7	1	3	6	15	42	9
1898	5	12	9	24	14	33	7	17	5	12	7	17	7	17	6	14	3	7	...	...	...	...	1	2	64	13
1899	2	5	3	8	1	2	...	...	...	...	1	2	2	5	5	12	2	5	...	...	1	2	2	5	19	4
1900	4	9	4	10	3	7	1	2	6	14	8	19	...	...	6	14	6	14	2	5	5	12	2	5	47	9
1901	4	9	5	13	6	14	2	5	3	7	3	7	3	7	7	16	11	26	7	16	7	17	5	11	63	12
1902	4	9	2	5	9	20	...	...	10	23	16	37	13	29	14	32	4	9	5	11	3	7	4	9	84	16
1903	6	13	2	5	4	9	3	7	3	7	7	16	9	20	10	22	7	16	6	13	3	7	4	9	64	12
1904	4	9	2	5	4	9	5	11	3	7	2	5	...	...	3	7	1	2	...	...	...	...	...	...	24	4
1905	...	...	2	5	2	4	1	2	3	7	5	11	6	13	5	11	14	32	11	24	8	18	7	15	64	12
1906	19	41	23	55	24	52	19	42	17	37	8	18	9	19	3	6	4	9	13	28	8	18	4	9	151	28
1907	2	4	...	...	1	2	...	...	3	6	1	2	2	4	4	9	...	...	2	4	...	...	2	4	17	3
1908	2	4	3	7	3	6	2	4	1	2	4	9	10	21	6	13	4	9	4	8	1	2	1	2	41	7
1909	...	...	1	2	1	2	8	17	8	17	11	24	22	46	16	33	21	45	10	21	12	26	7	15	117	21
1910	4	8	12	27	10	21	11	23	9	19	16	34	8	16	4	8	4	9	4	8	1	2	...	...	83	15
1911	1	2	4	9	3	6	6	13	8	16	5	11	5	10	3	6	5	11	2	4	3	6	3	6	48	8
1912	8	16	2	4	6	12	3	6	4	8	2	4	1	2	...	...	3	6	4	8	...	...	...	...	33	6
1913	...	...	3	7	2	4	1	2	2	4	4	8	7	14	7	14	5	10	2	4	4	8	4	8	41	7
1914	6	12	4	9	5	10	9	18	12	24	14	29	23	45	8	16	6	12	3	6	3	6	...	...	93	16
1915	5	10	...	...	...	...	2	4	3	6	...	...	2	4	2	4	1	2	3	6	...	...	3	6	21	3
1916	4	8	5	11	5	10	11	22	8	16	4	8	10	19	5	10	2	4	7	14	1	2	1	2	63	10
1917	1	2	2	4	...	...	1	2	3	6	2	4	6	12	3	6	5	10	4	8	6	12	5	10	38	6
1918	12	23	25	53	42	80	28	55	27	51	27	53	36	69	11	21	12	24	23	44	1	2	1	2	245	40
1919	3	5	3	5	1	2	1	2	2	3	2	3	1	2	4	7	2	3	...	...	1	2	3	5	23	3
1920	4	6	11	20	...	...	1	2	3	5	3	5	4	6	5	8	8	13	7	11	4	7	6	10	56	8

Since this date recognized cases of the disease have been kept out of school, but placarding houses with warning signs has been ineffective in keeping persons out of infected households and patients from associating with other children on the streets and elsewhere.

TABLE 68.—*Maximum incidence of mortality and maximum and minimum incidence of morbidity from whooping-cough, by months, from 1856 to 1920, inclusive, and from 1897 to 1920, inclusive, respectively, and the percentage of each to total number of years.*

Months.	Months in 65 years in which maximum mortality-rate obtains.		Months in 24 years in which maximum morbidity-rate obtains.		Months in 24 years in which minimum morbidity-rate obtains.	
	No.	Percentage to total years.	No.	Percentage to total years.	No.	Percentage to total years.
Jan.	6	9	1	4	1	4
Feb.	5	8	6	25	4	17
Mar.	4	6	1	4	3	13
Apr.	3	5	2	8	...	...
May	1	2	2	8	2	8
June	5	8	1	4	...	...
July	11	17	4	17	1	4
Aug.	15	23	2	8	...	...
Sept.	9	14	...	...	2	8
Oct.	3	5	...	...	4	17
Nov.	2	3	1	4	...	...
Dec.	1	2	4	17	7	29
Total	65	100	24	100	24	100

DIPHTHERIA AND "MEMBRANOUS" OR TRUE CROUP.

Local chronicles are strangely silent on the subject of this ancient disease described under many different names, which were gradually displaced by the term diphtheria given it by Bretonneau in 1821. It is not known whether the serious epidemic in New York City in the latter part of the eighteenth century, described so well by Dr. Samuel Bard as angina suffocativa or sore-throat distemper and later identified with diphtheria, reached Baltimore. Croup and membranous croup were credited with a considerable number of deaths in 1812 and each year thereafter until 1898. Charles Frick (47) in 1855 included them among the "zymotic" diseases. The term diphtheria did not appear in the local statistical nosology until 1860, when it was credited with 7 deaths, in contrast to 293 for membranous croup. By 1863 the proportion was 162 to 294, in 1872 it was 100 to 162, and not until 1887 was it the same. In the course of the next decade, croup or membranous croup gradually gave place in usage, and by 1898 it had become a subheading under diphtheria. It will be noted that diphtheria did not appear in the causes of death until two years after the beginning of the epidemic visitation in 1858. The number of deaths ascribed to sore throat, cynanche tonsillaris, angina, and inflammation of the throat was too small to have embraced deaths from

typical faucial diphtheria if the latter had been at all frequent and fatal before this date.

For any proper estimation of the real relation of true or membranous croup to diphtheria in Baltimore, it is necessary briefly to review opinions held concerning their identity during the period under consideration. Home (61), of Edinburgh, who gave a good description of croup in 1765, regarded it as a primary disease occurring independent of a previous angina. Bard (62), writing in 1789, regarded croup and epidemic angina as the same disease. Bretonneau, 1821, 1825, and 1826, was the first to recognize that the nasal, faucial, laryngeal, ocular, cutaneous, and genital false-membranous lesions were all manifestations of a specific local inflammation. His view of the identity of croup and diphtheria was widely accepted, particularly in France. It was disputed, however, especially in Germany, under the leadership of Virchow. The great French clinician Trousseau, while in general agreeing with Bretonneau's views, impressed upon many his own opinion that diphtheria was a general, and not primarily a local, affection. The correctness of Bretonneau's teachings were demonstrated finally by Roux and Yersin in 1888–1890, in their experimental investigations on *B. diphtheriæ* described by Klebs in 1883 and cultivated by Loeffler in 1884. The mass of clinical and laboratory investigations since the development of the antitoxin treatment in 1894 and of the diphtheria culture test in 1896 have further confirmed them.

The manuscript lectures of William T. Howard, sr. (56), written about 1867 and illustrated with his views of personally observed cases, throw valuable light upon the characteristics of membranous croup and diphtheria in Baltimore and the views locally current concerning them at that time. His description of primary faucial diphtheria, with or without involvement of the nares, larynx, conjunctiva, esophagus, skin, and genitals, was in general agreement with those of Bretonneau and other French authors and of leading contemporary writers of England, New York, and Philadelphia. However, on account of the profound intoxication which characterized it, he, in opposition to Bretonneau, held diphtheria to be primarily a general systemic disease, to which the cyanosis, purpura, cardiac embarrassment, convulsions, coma, and paralysis, as well as the swelling of the lymph-glands and the inflammatory processes of the fauces, nares, larynx, esophagus, and other organs were all secondary. Of croup he recognized three types: The spasmodic or false croup without false membrane and rarely fatal, membranous or true croup, and diphtheritic croup. The latter was regarded as a fortuitous complication of true diphtheria. Membranous or true croup, though the false membrane in the larynx and certain clinical symptoms were identical with those of diphtheritic croup, he held, in opposition to the French writers, to be a separate and distinct disease. Attacking young children and insidious in its onset and course, it was unattended by high fever, prostration, and other symptoms of intoxication. Hoarseness, gradual loss of voice, progressive difficulty in breathing, ending usually in suffocation from mechanical closure of the larynx, were the cardinal symptoms. The mind was unaffected till near the end, and the coma, hemorrhages, and swellings of cervical lymph-glands, so characteristic of diphtheria, were absent. Nor did those who escaped death by suffocation develop paralysis, so frequent in diphtheria. The inflammatory process did not, as was the case with diphtheritic croup, involve other organs than the larynx. Membranous croup,

unlike diphtheria, was a sporadic disease, never epidemic, and affected a single child in a family or neighborhood. "Until within a very few years past (since 1858) no living American physician had seen a genuine widespread epidemic of diphtheria, and yet all had ever been familiar with membranous croup."

This primary membranous croup was common enough, and unless tracheotomy was performed was fatal in 90 per cent of the cases. Such, then, must have been the characteristics of the membranous croup held responsible for such high mortality from 1812 until long after 1870. In reply to the question, was this diphtheria, it may be said that some years later (before 1880 at least), with larger experience, Dr. Howard changed his opinion and taught that membranous croup and diphtheritic croup were and had always been the same disease, and that the confusion had been due to differences in the character of diphtheria before and after the epidemic invasion of 1858. About 1885 it became generally recognized in Baltimore that diphtheria might be primary in the nose, throat, larynx, or elsewhere and remain confined to the original seat, or descend or ascend as the case might be, and that contact with a case of primary laryngeal diphtheria, or true croup, was often followed by the development of faucial diphtheria in persons so exposed, and vice versa. Welch's illuminating address on the causation of diphtheria before the Medical and Chirurgical Faculty in 1891 dispelled lingering doubts in the minds of Baltimore physicians and convinced them of the unity of faucial diphtheria and membranous croup under the causal agency of *B. diphtheriæ*.

In the light of the foregoing considerations, it seems reasonably certain that the deaths accredited to croup and membranous croup in the local statistical nosology since 1812 belong to the category of laryngeal diphtheria, with or without involvement of other structures, and that the whole number of deaths assigned to this rubric and to diphtheria probably fall short of the whole number. Some deaths due to diphtheria were probably classified under complicating affections, and there was doubtless some confusion with scarlet fever, particularly when the two diseases were at the height of their careers.

From table 60 and graph 17 the course of diphtheria, as determined by annual mortality-rates, may be followed through 109 years. In the curve of mortality as expressed in annual rates at least six separate and well-defined waves appear: (1) 1812–1831, (2) 1832–1841, (3) 1842–1875, (4) 1876–1890, (5) 1891–1893, (6) 1894–1908. Since the latter date the disease has, except for a sudden rise in 1919, run a course fairly stable. During the first period, covering 19 years, the annual rates were relatively high, and in 4 years surpassed 100. The second wave, extending over 10 years, was considerably lower, with 54 as the highest annual rate. The third wave, covering 33 years, reached and maintained a relatively high level, with rates over 100 in 16 years and between 80 and 100 in 10 years. In the fourth wave, embracing 14 years, occurred the highest annual rates attained, over 200 in 3 years (255 in 1881, 263, in 1882, and 220 in 1883), and over 100 in 6 other years. In the fifth wave, covering 4 years, the highest rate was 97. The long final wave with its peak in 1898, with a rate of 80, tailed off very gradually. Nearly all these waves are characterized by minor elevations and depressions, which break the smoothness of their curves. It will be noted that the third and longest wave had reached a relatively high level (but no higher than the highest point attained by the first wave)

before 1860, when the term diphtheria came into the statistical nosology. However, as above indicated, during the years immediately following 1860, a relatively large proportion of the deaths in this group were still classified under croup.

Viewed from another angle, namely, by comparing the average annual death-rates for 5-year periods from 1815 to 1920, it appears very clearly (table 61 and graph 18) that the period under observation begins with the end of the crest of a long wave of relatively high mortality, only 9 years of which, 1812–1820, come under view, with a sharp decline during the next 10 years, 1820–1830. From this point begins the second wave the whole extent of which is in view. Rising very gradually between 1835 and 1840, and remaining stationary during the next 5 years, the ascent is first rapid and then again gradual to a peak reached in 1861–1865. From this, after a second recession occupying a 10-year period, the ascent is resumed to a second peak in 1881–1885. The 5-year period ending in 1885 marks the acme; never before was its lethal power so great. During the following 5 years there is an abrupt decline from 195 to 67, a point maintained with but slight variation for 10 years, 1890–1900. The mortality-rates as averaged for 10-year periods (table 61, graph 19) fell continuously and sharply from 91 in 1812–1820 to 39 in 1830–1840. During the succeeding 30 years they ascended steadily and by equal steps to a peak with a rate of 136 in 1860–1870. Falling slightly in the next 10-year period, the rates had reached 131 by 1880–1890. From this point they fell precipitately to 68 in 1890–1900, or to about the level attained in 1840–1850. This remarkable tidal-wave of mortality rose through a period of 30 years to a crest, which, though broken was held for 20 years and then fell in 10 years by two-thirds of its rise. The descent in the rates during the 20-year period after 1901, to the low level of 13 occurred under altered conditions. Since, as will be shown later, almost the whole of the mortality from diphtheria occurs in individuals under the tenth year, rates specific for this age-group for the census years 1830 to 1920, inclusive, which are presented in table 64 may be studied with profit. While the rates for these selected years represent, for the most part, by no means the peak-rates of the corresponding periods, they illustrate fairly accurately the rise in mortality from about 1850 to the climax in the ninth decade of the last century, the subsequent gradual decline in the preantitoxin days and the conspicuous drop after 1900. It is evident that changes in the proportion of this age-group in the population in the last 20 years has been too slight to have exerted any important influence upon this decline.

In spite of the evidence that diphtheria never appeared in epidemic outbreaks in Baltimore before 1858 and that in its prevalent form as membranous croup up to that date it appeared only sporadically and was not evidently spread from one person to another by personal contact, it was nevertheless responsible for relatively high death-rates between 1812 and 1823 and between 1847 and 1858. Indeed, it was only between 1859 and 1868 and between 1877 and 1883 that the rates conspicuously surpassed those that often obtained before 1858.

The data from which morbidity and case fatality in diphtheria may be studied date from 1893, the year in which the mortality-rate fell to the lowest level since 1881. Since in this and the 3 succeeding years the cases were reported so inadequately and their monthly distribution was not recorded, the reported cases for this period have not been included in the regular tables.

For these 4 years the absolute and relative figures for mortality and case fatality were as presented in table 69.

From these figures with continuously rising morbidity-rates (and except in 1896 rising mortality-rates also), which were considerably lower than ever again achieved (except in 1909 and 1910) and associated with steadily falling case-fatality rates, it is clear that comparison with later years is not warranted. In the first two of these years antitoxin was not available, and during the last two it could not have been very widely used. It is particularly to be noted that the above case-fatality rates can not with justice be taken as criteria for comparison with rates during the antitoxin period.

TABLE 69.

Year.	Cases.	Morbidity-rate per 100,000.	Deaths.	Per cent case fatality.
1893	346	76	210	60.7
1894	409	88	231	56.5
1895	629	133	310	49.3
1896	653	136	280	42.9

Turning to tables 70 and 71, it will be observed that there is a close correspondence between the course of the curves for mortality and morbidity since 1897. After a steady fall in both until 1910, they were subject to an upward wave during the next 3 years, from which there was a descent to the lowest points reached in the former in 1918 and in the latter in 1917. They rose together and markedly in 1919 and descended in 1920. From this close correspondence it would appear that the cases during this time have been reported with a fair degree of accuracy and evenness, and that the courses of morbidity and mortality must have been influenced by causes acting at the same time and on the whole with very much the same degree of force.

It is evident that the medical and administrative agencies that have tended to reduce the death-rate (more accurate and earlier diagnosis, antitoxin treatment, and the extension of the use of intubation) have not seriously influenced case incidence; for every case saved from death, until the augmentation of the restrictive measures after 1910, and especially after 1915, meant a potential carrier to spread the disease and thus to increase the incidence rate. While there was a considerable fall in incidence in 1916, 1917, and 1918, after the imposition of much more restrictive measures than had before obtained, with special emphasis on the use of the culture method to govern the control of convalescents and carriers, the morbidity-rates surpassed those of 1913, 1914, and 1915. As a matter of fact, the average morbidity rate for the 5-year period ending in 1920 is scarcely lower than that ending in 1910, 156 and 159, respectively.

From the average morbidity-rates for the 5-year periods (table 71) it is clear that, on the whole, the more intensive efforts to curtail diphtheria during the last 5 years were associated with results no better than during the 5 years ending in 1910. In so far as these data justify conclusions, it may be said that under the conditions obtaining in Baltimore the invasive capacity of diphtheria is inconstant, that the course of morbidity preserves its tendency to run

in waves, and that restrictive measures as applied exert, on the whole, but comparatively little influence upon the relative incidence of the disease over a considerable term of years. In 1919 and 1920 the incidence of the disease relative to the population was very much the same as in 1901, 1913, and 1914. It may be argued, perhaps with justice, that the waves noted would have reached higher levels but for the interferences interposed by publicly and privately directed activities. So far as may be judged from the experiences of 1921, the only year for which the necessary data are available, morbidity from diphtheria has been profoundly influenced by age, color, and sex. Rates specific for these categories for this year are given in table 66. While the disease occurred in every decade of life up to the ninth, approximately three-fourths of the cases were in individuals under the tenth year of age. Considering this age-group first, it will be noted that the rates were higher in the first than in the second 5 years of life and that the incidence was particularly high in the first year. From the tenth year on, the rate of incidence decreased through the decades in regular order, with the exception that the rate was higher in the eighth than in the seventh. In respect of race, all cases in individuals over the thirty-ninth year of age were in whites and in every age-group below this period of life, with the exception of the first year, the attack rate was markedly higher in whites than in negroes. While, on the whole, in the first two decades of life the incidence was greater in males than in females in both races, the reverse was true from the third to the seventh decade, inclusive. This change in order of incidence is perhaps due, in some degree at least, to the greater facilities falling to the lot of women in household life for contact with cases of the disease.

The effect of season upon the incidence and mortality of diphtheria is very distinct. From the curve of the monthly annual mortality-rates (table 70) it is clear that the highest fatality has commonly occurred in the fall and early winter and the lowest fatality almost always in the warmer months. In typical years, from its low point in the summer, the mortality-rate rises considerably and often abruptly in September and continues to ascend through the fall months to a peak in December or January, from which the decline is gradual, though often irregular, to the low point in midsummer. Months of maximum mortality, between 1856 and 1920, as expressed in percentages of the total number of years (table 72) were: December 28, January 25, November 22, October 15, February 9, and March 2. Months of minimum mortality similarly expressed were: July 38, August 18, June 17, May 14, April 8, September 3, and November 2. The highest rates never occurred between April and September, inclusive, and with the exception of one year, the lowest incidence fell within these months.

The relation between season and the incidence of diphtheria is shown even more accurately in the monthly annual morbidity-rates (table 71) for the 24 years, 1897–1920. The curves of the morbidity and mortality rates for these years follow the same trend, the latter lagging, as is to be expected, about a month behind the former. Months of maximum incidence, as expressed in percentages of occurrence in these 24 years (table 72), were: November 38, December 33, January 17, October 8, and February 4. As determined on the same basis, months of minimum incidence were: July 50, June and August,

TABLE 70.—*Number of deaths by months and years and the monthly annual and annual rates of death, per 100,000 living inhabitants, from diphtheria and croup, from 1856 to 1920, inclusive.*

D = death. R = rate.

Year.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1856	32	195	17	115	23	140	10	63	7	43	11	69	4	24	5	30	15	94	19	116	12	76	25	152	180	93
1857	22	130	17	112	16	95	11	67	8	47	14	86	8	47	6	36	7	43	13	77	23	141	15	89	160	81
1858	14	81	12	77	21	121	20	119	27	156	9	54	7	40	14	81	20	119	25	144	25	149	21	121	215	106
1859	31	175	18	112	19	107	17	99	17	96	7	41	12	68	13	73	13	76	20	113	28	163	14	79	209	100
1860	34	187	32	194	40	220	23	130	22	121	14	79	15	82	13	71	20	113	28	154	24	136	34	187	299	139
1861	26	139	23	136	19	102	16	89	11	59	11	61	16	86	12	64	19	105	19	102	15	83	20	107	207	94
1862	29	151	19	110	28	146	22	119	13	68	16	86	17	89	26	136	34	183	35	183	38	205	43	225	320	141
1863	48	245	51	288	46	234	16	84	22	112	39	205	19	97	37	188	51	268	48	245	47	247	32	163	456	197
1864	32	159	46	253	59	293	35	180	41	204	28	144	20	99	27	134	33	170	54	268	32	164	40	199	447	189
1865	55	267	35	188	25	121	28	125	24	116	17	85	23	112	17	83	24	120	52	252	42	211	36	175	378	156
1866	47	223	36	189	33	156	33	162	20	95	15	73	8	38	18	85	23	113	31	147	27	132	39	185	330	133
1867	22	102	14	72	13	60	30	143	16	74	6	29	8	37	9	42	15	72	30	139	34	163	34	157	231	91
1868	35	158	31	155	30	136	23	107	24	109	14	65	3	14	13	59	22	103	29	131	47	220	37	167	308	118
1869	33	146	31	152	42	186	22	100	36	159	20	91	15	66	17	75	20	91	30	133	50	228	40	177	356	134
1870	42	181	36	172	44	190	22	98	19	82	9	40	7	30	12	52	13	58	31	134	31	138	19	82	285	105
1871	27	114	32	150	26	110	24	105	17	72	8	35	8	34	8	34	21	92	29	122	27	118	21	89	248	89
1872	19	78	24	110	10	41	22	94	13	54	12	51	12	50	29	120	51	218	34	140	69	294	66	272	361	127
1873	27	109	23	103	27	109	32	134	25	101	22	92	14	57	15	61	19	79	22	89	28	117	32	129	286	98
1874	29	115	37	162	30	118	22	90	23	91	22	90	12	47	16	63	15	61	26	103	43	175	31	122	306	103
1875	40	155	23	98	16	62	11	44	13	50	17	68	12	46	13	50	14	56	25	97	15	60	38	147	237	78
1876	26	98	24	101	25	95	16	63	21	79	17	66	5	19	14	53	23	90	23	87	21	82	34	129	249	80
1877	22	81	26	107	27	100	18	69	21	78	34	130	39	144	44	163	73	279	82	304	79	302	91	337	556	175
1878	42	152	47	189	50	181	30	112	29	105	25	94	15	54	28	102	34	127	41	149	62	232	49	178	452	139
1879	44	156	44	173	45	160	24	88	34	121	25	92	9	32	15	53	35	128	65	231	78	286	66	234	484	146
1880	61	212	33	127	44	153	27	97	29	101	19	68	26	90	28	97	28	101	62	216	47	169	64	223	468	138
1881	67	228	46	174	33	112	42	148	32	109	34	120	57	194	51	174	87	306	135	460	132	465	166	566	882	255
1882	106	354	68	251	42	140	60	207	45	150	35	121	31	103	48	160	101	348	131	437	121	417	141	471	929	263
1883	95	311	84	304	83	272	52	176	43	141	40	135	36	118	40	131	77	260	86	281	71	240	85	278	792	220

1884	51	164	43	153	35	112	16	53	30	96	13	43	19	61	37	119	46	152	64	205	61	202	55	176	470	128
1885	49	154	29	101	14	44	23	75	22	69	11	36	12	38	28	88	51	166	69	217	52	169	40	126	400	107
1886	44	136	18	61	25	77	23	73	18	56	14	45	15	46	12	37	21	67	47	145	45	143	36	111	318	83
1887	43	130	19	64	14	42	13	41	9	27	20	63	14	42	12	36	19	59	47	142	48	150	44	133	302	78
1888	28	79	19	59	23	65	17	49	7	20	8	23	6	17	11	31	17	49	33	93	29	84	23	65	221	53
1889	22	61	17	52	19	52	17	48	10	28	9	26	1	3	10	28	13	37	25	69	35	100	30	83	208	49
1890	35	95	20	60	34	92	19	53	22	60	7	20	14	38	25	68	18	50	27	73	49	137	49	133	319	73
1891	30	80	31	91	23	61	14	39	28	75	24	66	14	37	18	48	35	96	49	131	72	198	56	149	394	89
1892	69	181	48	139	51	134	36	97	34	89	26	70	16	42	7	18	35	95	37	97	38	103	41	107	438	97
1893	31	80	11	31	21	54	19	51	23	59	11	29	9	23	9	23	13	35	14	36	28	75	21	54	210	46
1894	20	51	17	48	15	38	15	39	7	18	5	13	7	18	21	53	11	29	24	61	43	113	46	117	231	50
1895	26	65	22	61	17	42	18	46	12	30	17	44	14	35	24	60	28	72	30	75	47	121	55	117	310	66
1896	25	62	27	74	20	49	20	51	16	39	19	48	10	25	11	27	21	53	28	69	35	89	49	121	281	59
1897	46	111	17	46	23	56	23	58	17	41	17	43	8	19	23	56	25	63	60	145	55	138	46	111	360	74
1898	32	76	31	82	28	67	21	52	14	33	27	67	40	96	22	53	46	114	54	129	53	131	27	64	395	80
1899	29	68	35	91	25	59	9	22	9	21	18	44	17	40	19	45	22	54	36	85	40	97	53	125	312	62
1900	40	93	35	90	29	67	26	62	10	23	10	24	17	39	11	26	17	41	28	65	36	86	20	46	279	55
1901	30	69	20	51	14	32	11	26	16	37	14	33	7	16	4	9	7	17	14	32	20	47	12	27	169	33
1902	15	34	3	6	6	14	8	19	10	23	5	12	2	5	12	27	10	2	15	34	21	49	23	52	130	25
1903	11	25	17	42	8	18	10	23	13	29	5	12	8	18	7	16	12	28	23	51	21	48	25	56	160	30
1904	15	33	14	34	8	18	8	18	4	9	8	18	8	18	6	13	9	21	16	35	13	30	6	13	115	22
1905	13	28	7	17	5	11	6	14	4	9	4	9	4	9	5	11	7	16	14	30	16	36	17	37	102	19
1906	9	19	6	14	10	22	13	29	9	19	6	13	7	15	5	11	9	20	14	30	13	29	14	30	115	21
1907	10	21	3	7	8	17	5	11	10	21	4	9	6	13	7	15	3	7	7	15	6	13	11	23	80	14
1908	4	8	6	14	5	11	4	9	7	15	4	9	5	11	3	6	5	11	6	13	3	7	12	25	64	11
1909	9	19	9	21	11	23	6	13	5	10	4	9	6	12	3	6	5	11	4	8	8	17	6	12	76	13
1910	10	21	2	5	5	10	1	2	4	8	2	4	...	...	2	4	5	11	6	12	11	23	16	33	64	11
1911	6	12	10	23	7	14	1	2	3	6	7	15	2	4	2	4	7	15	6	12	7	15	10	20	68	12
1912	13	26	7	16	2	4	3	6	4	8	1	2	1	2	3	6	6	13	12	24	22	46	19	38	93	16
1913	12	24	6	13	2	4	5	10	6	12	5	10	4	8	3	6	5	10	8	16	13	27	12	24	81	14
1914	17	34	6	13	7	14	5	10	7	14	1	2	2	4	8	16	1	2	6	12	17	35	9	18	86	14
1915	13	25	8	17	6	12	5	10	3	6	2	4	2	4	4	8	9	18	6	12	9	18	12	23	79	13
1916	9	17	8	17	9	17	2	4	5	10	2	4	3	6	4	8	5	10	9	17	1	2	5	10	62	10
1917	9	17	5	11	3	6	9	18	7	13	2	4	2	4	3	6	4	8	4	8	5	10	5	10	58	9
1918	8	15	7	15	6	11	8	16	6	11	...	...	4	8	1	2	...	...	15	29	7	14	9	17	71	11
1919	12	20	11	20	10	16	15	25	11	18	8	14	8	13	10	16	6	10	15	24	22	37	18	29	146	20
1920	23	37	11	20	10	16	11	18	3	5	5	8	3	5	...	...	4	7	9	14	14	23	7	11	100	14

TABLE 71.—*Morbidity by months and years and monthly annual and annual rates of morbidity, per 100,000 living inhabitants, from diphtheria and croup, from 1897 to 1920, inclusive.*

C = cases. R = rate.

Year.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total.			Percentage case fatality.	
	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	Average rate of morbidity by 5-year periods.	Annual.	Average by 5-year periods.
1897	119	288	88	236	88	213	71	178	66	160	55	138	37	90	46	111	89	223	247	599	330	826	384	931	1620	333	...	22.22	.....
1898	231	552	159	420	102	244	86	212	71	170	99	244	106	253	153	365	262	647	284	678	322	795	202	482	2077	421	...	19.02	.....
1899	137	323	121	315	105	247	79	192	63	148	68	165	49	115	128	301	178	433	238	560	305	742	309	727	1780	356	...	17.53	.....
1900	269	625	198	509	171	397	115	276	101	235	78	187	87	202	70	163	147	353	248	576	228	547	146	339	1858	366	369	15.02	18.45
1901	149	341	100	254	119	273	82	194	105	241	67	159	44	101	43	99	78	185	150	344	131	310	101	231	1169	227	...	14.46	.....
1902	91	206	80	200	88	199	62	145	42	95	26	61	39	88	59	133	78	182	149	337	133	311	125	283	972	187	...	13.37	.....
1903	116	259	100	247	88	196	114	263	107	239	57	131	95	212	113	252	143	330	178	397	182	420	168	375	1461	277	...	10.95	.....
1904	159	351	92	225	69	152	77	175	65	143	59	134	69	152	73	161	129	294	154	339	154	351	172	379	1272	238	...	9.04	.....
1905	128	279	80	193	62	135	70	158	63	137	55	124	41	89	45	98	69	155	101	220	107	241	141	307	962	178	221	10.60	11.68
1906	146	314	68	162	86	185	89	198	79	170	58	129	48	103	50	108	117	260	167	359	145	322	119	256	1172	214	...	9.81	.....
1907	133	283	66	155	85	181	70	154	72	153	39	86	35	74	45	96	60	132	81	172	79	174	102	217	867	157	...	9.23	.....
1908	90	189	69	161	87	183	69	150	70	147	35	76	34	72	38	80	64	139	101	212	89	193	102	214	848	151	...	7.55	.....
1909	87	181	109	251	99	206	45	97	56	116	40	86	33	69	25	52	39	84	71	148	89	191	63	131	756	134	...	10.05	.....
1910	68	140	68	155	53	109	50	106	58	119	30	64	15	31	45	93	75	159	96	198	104	221	131	270	793	139	159	8.07	8.94
1911	107	217	118	266	138	280	60	126	42	85	32	67	28	57	52	106	89	187	98	199	151	318	126	256	1041	180	...	6.53	.....
1912	105	212	85	190	79	159	61	127	38	77	34	71	30	60	38	77	60	125	144	290	195	406	170	343	1039	178	...	8.95	.....
1913	107	214	103	228	109	218	55	113	53	106	66	136	49	98	57	114	108	223	195	389	231	476	176	351	1309	222	...	6.19	.....
1914	149	294	138	302	111	219	58	118	68	134	49	100	40	79	55	109	81	165	156	308	173	353	155	306	1233	207	...	6.97	.....
1915	152	298	98	212	110	215	54	109	59	116	43	87	64	125	59	116	92	186	121	237	167	338	132	258	1151	191	196	6.86	7.10
1916	127	246	79	170	58	113	47	94	33	64	29	58	39	76	42	81	50	100	74	144	65	130	88	171	731	120	...	8.48	.....
1917	91	175	73	155	50	96	45	89	43	83	18	36	24	46	31	60	56	111	73	140	113	225	75	144	692	113	...	8.38	.....
1918	80	153	59	125	47	90	46	91	62	118	37	73	38	72	22	42	33	65	77	147	75	148	95	181	671	109	...	10.58	.....
1919	131	214	112	202	139	227	126	213	109	178	86	145	70	114	76	124	110	186	214	349	227	383	225	367	1625	225	...	8.98	.....
1920	202	324	134	238	146	234	113	187	92	148	50	83	52	83	41	66	88	146	165	265	237	393	229	367	1549	211	156	6.46	8.58

each 21, and May 8. September, March, and April were never months of either maximum or minimum incidence.

Owing to the incompleteness of case reporting, it is manifestly impracticable to calculate with any accuracy a normal diphtheria case-fatality rate for Baltimore during the preantitoxin days. In 1895 and 1896 antitoxin was used to some extent; but if, for the sake of establishing a standard somewhat arbitrary, 1896 be taken as a representative year, and the favorable influence of the antitoxin used on those able to pay for it and willing to waive prejudice against the new remedy be considered as offsetting the defectiveness of case reporting, the normal diphtheria case-fatality rate without antitoxin treatment would be 42.9 per cent. The much lower case-fatality rate in 1897 (22.2 per cent) when antitoxin was first freely distributed and therefore fairly widely used, may then

TABLE 72.—*Maximum and minimum incidence of mortality and morbidity from diphtheria by months, from 1856 to 1920, inclusive, and from 1897 to 1920, inclusive, respectively, and the percentage of each to the total number of years.*

Months.	Months in 65 years in which maximum mortality-rate obtains.		Months in 65 years in which minimum mortality-rate obtains.		Months in 24 years in which maximum morbidity-rate obtains.		Months in 24 years in which minimum morbidity-rate obtains.	
	No.	Percentage to total years.	No.	Percentage to total years.	No.	Percentage to total years.	No.	Percentage to total years.
Jan.	16	25	...	...	4	17	...	...
Feb.	6	9	...	...	1	4	...	...
Mar.	1	2	...	...	...	...	...	...
Apr.	...	...	5	8	...	...	...	...
May	...	...	9	14	...	...	2	8
June	...	...	11	17	...	...	5	21
July	...	...	25	38	...	...	12	50
Aug.	...	...	12	18	...	...	5	21
Sept.	...	...	2	3	...	...	...	...
Oct.	10	15	...	...	2	8	...	...
Nov.	14	22	1	2	9	38	...	...
Dec.	18	28	...	...	8	33	...	...
Total ..	65	100	65	100	24	100	24	100

be taken as an index, admittedly only approximate, of the curative value of antitoxin as then used and of its immediate actual influence upon mortality in this disease. In this year, as compared with 1896, while the morbidity-rate increased by 140 per cent, the mortality-rate increased by only 25 per cent, and the case-fatality rate fell by 48 per cent. The case-fatality rate fell by very gradual steps in the face of continually improved case reporting during the next 7 years and reached the low point of 9 per cent in 1904. The lowest point attained was 6.2 per cent in 1913. During the first 4 years during which antitoxin was freely used, 1897–1900, the average case-fatality rate was 18.5 per cent, and the average rates for 5-year periods from 1901 to 1920 were 11.7, 8.9, 7.1 and 8.6 per cent. It will be noted that unless it be assumed, and for this there is no warrant, that case reporting has become much more accurate in the last 5 years, the treatment of diphtheria and the management of diphtheria cases in Baltimore reached its high point of efficiency by 1915, and during the last quinquennium ground has actually been lost. It is of interest that, while

the trend of the curve of the case-fatality rate follows very closely those of both morbidity and mortality until 1909, since this date the agreement in trend has been almost completely lost so far as concerns morbidity and very much modified as concerns mortality.

In recent years, the mortality from nasal and faucial diphtheria, uncomplicated by laryngeal involvement, has been comparatively small. Of the total number of 248 deaths ascribed to diphtheria in 1919 and 1920, Dr. John F. Hogan found on personal inquiry of the attending physicians that 203, or 82 per cent, had laryngeal diphtheria, and that in 45 or 18 per cent the disease did not involve the larynx. For the two years the average mortality-rates were 20 and 14, respectively.

Of the 3,184 deaths credited according to the loose classification of those times to croup and to diphtheria together in the 10-year period 1863–1872, 2,258 or 70 per cent were apportioned to the former and 952 or 30 per cent to the latter. If it be justifiable to assume that in this series deaths assigned to croup represented laryngeal diphtheria and those ascribed to diphtheria represented faucial and nasal diphtheria without laryngeal involvement, it would appear that antitoxin treatment has exercised a less striking influence upon the relative fatality of these two anatomical forms of diphtheria than is commonly supposed. Unfortunately, for neither of these groups are data available as to the relative morbidity of laryngeal and faucial diphtheria.

The influence of sex and color also upon mortality was signifiant for the 15-year period, 1906–1920, for which specific data are available. The 1,221 deaths during this period were distributed by sex and color as follows: White 1,129, negro 92, white males, 576, white females 553, negro males 47, negro females 45. The deaths among whites and negroes were in the ratio of 12 to 1, while the proportion of whites to negroes in the population was on the average 5.42 to 1; i. e., diphtheria was more than twice as fatal for whites as for negroes. In both races the fatality was distinctly higher in males than in females. This is greatly at variance with the experience for 1850, when, according to Frick, the mortality per 10,000 from croup was 8.5 in whites and 8.8 in negroes, and of the whole number of deaths for both races 49 per cent were in males and 51 per cent in females.

In tables 62 and 63 death-rates by age, color, and sex are given for the census years 1910 and 1920. No deaths occurred in individuals over the fortieth year, nearly the whole mortality fell within age-period 0 to 9 years, and over three-fourths of it below the fifth year of life. Of the 142 deaths from croup in 1850 analyzed by Frick (table 73), 134, or 94 per cent, were under 5 years of age. In both 1910 and 1920 the rates were much higher in whites than in negroes. In 1910 mortality was greater in males than in females in both races, and in 1920 in females than in males among whites and in males than in females among negroes.

Up to about 1900 the whole course of diphtheria in Baltimore may be regarded as natural and practically uninfluenced by artificial interferences, for certainly before 1898 no measures of a restrictive kind, which may by any stretch of the imagination be considered effective, were directed against the disease by the health department. And no one who has read the text-book directions or suggestions for the treatment of diphtheria or who has seen them applied will contend that, before the general use of the O'Dyer intubation method and of anti-

toxin during the late years of the nineteenth century, physicians, on the whole, saved more diphtheria patients than they killed. What influence immigration exerted upon the course of diphtheria in Baltimore it is impossible to say. The coincidence of the rise in the second wave with the large foreign migration starting in the fifth decade of the nineteenth century and of its fall with decrease in migration in its latter years may be significant. At any rate, it is not unlikely that the decline in the death-rate between 1820 and 1830 represented a true decrease in virulence of the type of diphtheria then locally prevalent, and that the second wave was associated, in part at least, with importation of the disease in more potent form from Europe during the exacerbation of the disease about the middle of the century. It is of considerable interest, in connection with the second wave, that during the 35 years, 1840–1875, marking its first phase, the average annual death-rate from diphtheria was 100, and during the 25 years of its second phase, 1875–1900, it was 107.

TABLE 73.—*Number of deaths and rate of death, per 100,000 living inhabitants, from croup, according to age, for 1850. Calculated from figures given in Frick's tables.*

Age-period.	Croup.	
	Deaths.	Rate.
Under 1 year	54	881
1 to 4 years	80	434
5 to 9 years	8	40
Under 10 years	142	318
10 to 19 years	...	...
20 to 29 years	...	...
30 to 39 years	...	...
40 to 49 years	...	...
50 to 59 years	...	...
60 years and over	...	...
Total	142	84

For this period there exist no data for morbidity-rates. Viewed from the annual mortality-rates, the curve of diphtheria mortality reached its highest point in 1882. From this date the fall in the death-rate was continuous to 1908, except for comparatively minor rises covering the years 1890–1892 and 1894–1900. These minor waves, to which attention has already been directed, did not approach, however, the immediately previous high level. It is to be noted that the highest point of this second minor wave, considerably lower than that of the one of 1890–1892, was in 1899. These two breaks in the curve of descent in the diphtheria mortality-rate may be regarded as reactions from a rather sudden fall and as an indication of a tendency of the disease to reach an equilibrium and a death-rate of between 60 and 70. On the other hand, as the artificial interferences, begun in 1897 and 1898, which will be more fully explained later, could not have offered any decided and compelling resistance until several years later, it is not unlikely that under natural conditions a much lower rate than 49 reached in 1889 might have been attained and the point of equilibrium established for a period at least around a rate of 40 or even lower, as obtained for the 20 years between 1826 and 1845.

It is interesting to note that in 1883 a high rate was recorded for scarlet fever, and that the rates for these two diseases fell simultaneously, though the descent in diphtheria was much less rapid and striking than in scarlet fever.

The development and application of restrictive measures against the spread of diphtheria were very gradual. As previously pointed out, though membranous croup was made reportable in 1882 and diphtheria in 1894, reports were not made at all until 1893, and not with any completeness until 1898 or 1900.

Though the bacteriological laboratory was available for diagnosis, and antitoxin was obtainable for protection and treatment in 1896 and 1897, it was some years before they were very generally used. It was not until 1898 that warning signs were posted on dwellings and institutions harboring diphtheria cases, that isolation of diphtheria patients was seriously attempted, that a negative throat-culture (taken by the attending physician or by the single throat inspector appointed this year) was required from the patient and household contacts before disinfection and release, and that children were not allowed to return to public schools without a certificate of recovery. During this same year there was instituted semi-weekly notification to each public school of the names and addresses of any pupils sick with diphtheria and scarlet fever. In 1900 a second throat inspector was appointed to make cultures for release of diphtheria convalescents.

Precautions against spread of the disease through contacts and carriers, by means of milk and other foods, and the control of milk and cream from farms and dairies exposed to known cases and contacts were not routinely undertaken, with any completeness at least, until after 1912. As late as 1910, in only 395 of the 793 cases of diphtheria reported was the diagnosis confirmed by culture, and of the 3,401 cultures for discharge taken by the throat inspectors and private physicians from convalescents and from contacts, only 289 were positive. The next year the throat inspectors began taking nasal as well as faucial cultures, but only one negative culture from each situation was required, and if either throat or nose culture were found negative on one occasion it was counted as permanently negative and future cultures were confined to the organ found positive. When diphtheria broke out in institutions, cultures were made from all the inmates, the carriers were isolated in a group, and those who were found negative on a single culture-test were discharged. In St. Vincent's Orphan Asylum, with its large population of sucklings and older children, in connection with these imperfect measures and the total lack of rooms for isolation of incoming as well as permanent inmates, diphtheria continued endemic.

In December 1915 these regulations and practices were so amplified that two consecutive negative cultures taken at intervals of at least 48 hours from both nose and throat were required before release of convalescents and contacts; all contacts and reported cases were submitted to culture; all carriers and all attendants, whether proven carriers or not, were isolated; and other members of households with diphtheria cases after two negative nose and throat cultures were allowed to mix with the public at will, if the isolation of the patient and any carriers in the households was complete, or on change of domicile. In the case of both convalescents and healthy carriers, virulence tests were made after the twenty-eighth day, and if their cultures proved non-virulent for guinea-pigs they were released. Within the next 2 years hospitals and institutions

receiving children were required, except in emergencies, to make cultures of prospective inmates before admission and to establish suitable isolation quarters for diphtheria cases and carriers or to send them to Sydenham Hospital. All cultures for discharge were required to be taken by representatives of the health department. Members of the classes of school-children developing diphtheria were cultured and those found to be diphtheria carriers excluded.

These procedures, with strict supervision of the disinfection of all milk utensils before returning to dairymen, enormously increased the work of the health department in connection with diphtheria. The work of the bacteriological laboratory was greatly augmented—from an average of 80 to 90 diphtheria cultures on an average day in the winter to 400. In 1920 there were 62,644 cultures examined, 14,037 from inmates of institutions and 48,607 from households or schools; of the latter number, 3,848 were submitted for diagnosis, 17,992 were from contacts, and 26,767 were for discharge of convalescents or contactive carriers, an average of over 160 diphtheria cultures every day in the year.

In the meantime, since 1910 an increasing number, but never any considerable moiety of the total number of cases of diphtheria, and some chronic carriers, were treated at Sydenham Hospital. This hospital, though inconveniently situated, faulty in design, and inadequately equipped, managed diphtheria cases in a manner wholly creditable until the depletion of its personnel during the war, and, while it can not have exerted any considerable influence upon restricting morbidity, it has undeniably been responsible for influencing favorably the mortality from this disease. Its chief service in this regard has been rendered in the intelligent care of cases of laryngeal diphtheria, many of which, however, have reached it too late to be saved by intubation, antitoxin, and nursing. Its clientele in this group of cases has been drawn largely from the poor and ignorant and often referred when *in articulo mortis* by physicians called after the disease was far advanced.

ACUTE INFLAMMATORY AFFECTIONS OF THE LUNGS AND PLEURA; I. E., BRONCHITIS, PNEUMONIA, AND PLEURISY.

The affections here considered are grouped upon a purely anatomical basis, and the only member of the group, croupous or lobar pneumonia, for which the evidence at hand indicates the action of a specific cause, is, certainly during most and probably during all of the period for which records exist, so hopelessly intermixed and confused in the nosological classification that it is not possible to separate it out with any reasonable degree of accuracy. Pleurisy is so evidently bound up with pneumonia that even in later years it can not certainly be set up as a separate category. Deaths listed under bronchitis undoubtedly included many due to pneumonia, and only recently was there a distinction made between acute and chronic bronchitis. In table 60, the categories to which deaths under these various groupings were assigned are arranged in chronological order. It will be noted that pleurisy alone appeared before 1818, played the leading rôle until 1822, and continued to be a serious rival of the other categories for many years later. Inflammation of the lungs made its appearance with credit for a relatively considerable number of deaths in 1818, then in a few years receded to an inconspicuous position, and did not become important

again until about 1850. It almost entirely disappeared after 1874. Pneumonia first appeared in the nosological classification in 1821, with a few deaths for 2 years; in 1823 it rivaled pleurisy and surpassed inflammation of the lungs and then practically disappeared, except for the 6 years between 1845 and 1850, until 1875, when it became the one prominent cause of death in this whole group. In the meantime, catarrhal fever, which in 1855 Frick held to be infantile pneumonia and bronchitis, appeared in 1823, and soon began to equal and then to surpass in numbers, first, any other, and then, about 1840, all other categories of this group. As late as 1898 a few deaths were ascribed to catarrhal fever. Broncho-pneumonia appeared in the nosology in 1879 with 4 deaths. The proportion of deaths classified under this heading increased very gradually, and finally by 1920 nearly half of the total number of deaths credited to pneumonia were classed under this heading.

Bronchitis appeared as a separate disease in 1841 (with 5 deaths), but was not ascribed any considerable number of deaths (46) until 1872. It lapsed completely in 1875 and appeared only once again, in 1898. It was supplanted by inflammation of the bronchi, to which an increasingly large number of deaths was credited until it in turn sank into oblivion in 1898. Capillary bronchitis appeared as a cause of death from 1878 until 1900. The terms "acute" and "chronic" bronchitis, introduced with the adoption of the international classification in 1899, have shared with each other all the deaths credited to bronchitis since that date.

From this rapid review it is clear that by no method of arrangement can the figures under these various categories be so grouped as to indicate with any reasonable degree of definitiveness the true proportion of deaths ascribable to acute or chronic bronchitis, or to broncho and lobar pneumonia, or to *primary* pleurisy. In the early days pleurisy must have included not only all forms of acute pneumonia, but some deaths from phthisis, chronic cardiac disease, and the like. Pneumonia, catarrhal fever, and inflammation of the lungs must have included some deaths of persons with bronchitis, acute and chronic, as well as deaths of individuals with various other acute and chronic diseases that would now be otherwise classified. Catarrhal fever and capillary bronchitis, synonyms for catarrhal pneumonia, properly belonged and, since 1900, have fallen to broncho-pneumonia. It is probable that in most if not all the fatalities ascribed to acute bronchitis the inflammatory process also involves the lung, and that this term as used signifies pneumonia, usually broncho-pneumonia. Particularly in the light of the experience of MacCallum and of other pathological anatomists, studying the abundant army material in the late war, it is very improbable that much dependence can be placed upon the diagnosis of broncho-pneumonia as distinguished from lobar pneumonia, in at least a very large proportion of instances as certified upon death certificates without post-mortem examination. Chronic bronchitis, to which some deaths continue to be ascribed to the end of the period, can not be separated from acute bronchitis before 1899, and is therefore included with acute bronchitis to avoid an inconsistency even greater were it omitted.

From these observations and explanations it would appear that rates calculated for any single one of the above categories would be without value; that rates calculated on the basis of the sums of the categories as arranged under bronchitis, or under pneumonia and pleurisy, can have no definitely significant

value; and that rates calculated on the basis of the sum of the deaths under all the categories relating to bronchitis, pneumonia, and pleurisy are relatively significant, but subject, of course, to uncertain errors due to idiosyncrasies of classification, to errors of diagnosis, and to the custom only in recent years successfully overcome of ascribing to bronchitis and pneumonia deaths of individuals with various acute and chronic diseases in which pulmonary complications are secondary.

Despite the numerous faults of classification above pointed out, it is evident from table 60, graph 17 (in which are given separately rates calculated for bronchitis, pneumonia, and the total of the two), that the acute pulmonic diseases were well established as important causes of death early in the nineteenth century. Taken together, they started with a death-rate of 139 in 1812 and in 1814 attained a rate (246) not surpassed until 1890–1896, and in 9 other years subsequent to the latter date. It was not until 1874 that bronchitis, introduced into the statistical nosology in 1841, began to rank significantly; and since 1904 its importance has gradually declined until by 1919 it had again become an insignificant factor. It will be noted that, while coincident with the rise here in the curve for bronchitis and a slight corresponding fall in the curve for pneumonia, the curve for the combined rate is not dependent upon the introduction of a new factor. On the whole, it seems improbable that the differentiation of bronchitis into separate statistical rubrics really increased in any considerable degree the number of deaths that otherwise would have been credited to acute pulmonic disease and thereby actually increased the rate.

In the course of the curve of the rate for the combined group of acute pulmonic diseases there are several noticeable waves. The first wave, covering a period of 20 years, began in 1812, reached its high point in 1814, with a rate of 246, and gradually subsided, after considerable fluctuations toward the end of the period, to a rate of 70 in 1831. The second wave, 1832–1840, reached its high point of 160 in 1835 and its low point of 83 in 1840. The third wave, 1841–1865, was marked by several minor waves. The highest rates attained were 170 in 1848 and 206 in 1852. A fourth wave reached a peak in 1872 with a rate of 222 and gradually descended to 150 in 1878. The next year the rate rose and maintained a rather constant level of about 200 until 1889. In this and the next year rates of 308 and 315 were reached and between 1892 and 1899 the annual rates varied between 224 and 290. After a rise to 317 in 1900, the rate fell to 203 in 1908. With minor fluctuations, the annual rate hovered around 225 until 1915; it began to rise in 1916, and, in the influenza year 1918, reached 607. During the next 2 years it fell to about 200. It will be noted that since about 1830 the rate for the acute pulmonic diseases has been rising.

The curve of the rates averaged for 5-year periods (table 61, graph 18) fell abruptly from a high point in 1812–1815 to 75 in 1821–1825; from this it ascended by gradual steps to a rate of 165 reached in 1851–1855. A drop during the next 10 years to 97 was followed by another gradual ascent to an average rate of 277 in 1891–1895. Following a graduated decline, a rate of 222 was reached in 1911–1915, and from this there was a jump to 305 in 1916–1920.

With the annual mortality rates averaged for 10-year periods (table 61, graph 19), from a peak of 159 in 1812–1820, the rates fell abruptly to 77 in 1821–1830. The peak of a second wave was attained in 1851–1860, with a rate

of 149. After a moderate drop to 122 in 1861–1870, the rate rose steadily to 272 in 1891–1900. Following a slight recession to 243 in 1901–1910, the rate rose to 264 in 1911–1920.

A straight line fitted to the curve of rates averaged by 5- and 10-year periods, from 1825 to 1920, would follow a progressively increasing death-rate from the pulmonic diseases during a period covering 95 years. The full significance of this fact and of the fall culminating in 1825 will be discussed in another section.

The absolute figures for deaths and the death-rates for broncho and lobar pneumonia from 1906 to 1920, and for bronchitis from 1905 to 1915, both for sex and color, are set forth in table 74. The lessons to be drawn from the curves

TABLE 74.—*Number of deaths and rate of death, per 100,000 living inhabitants, from pneumonia and bronchitis, according to color and sex, from 1905 to 1920, inclusive.**

D = death. R = rate.

TOTAL PNEUMONIA.

Year.	White.						Colored.					
	Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R
1905	....	....	....	....	....	....	....	....	....	....	....	....
1906	650	141	329	146	321	136	372	438	206	539	166	351
1907	685	147	376	165	309	129	409	475	224	577	185	391
1908	583	123	293	127	290	120	357	409	185	469	172	359
1909	723	151	366	157	357	146	392	443	204	510	188	388
1910	770	160	395	167	375	152	289	322	160	394	129	263
1911	733	150	378	158	355	143	381	419	211	512	170	342
1912	687	140	349	144	338	135	361	392	199	476	162	322
1913	797	160	417	171	380	151	401	430	212	500	189	372
1914	834	166	442	179	392	154	367	389	204	475	163	317
1915	768	152	399	160	369	144	364	381	200	459	164	315
1916	947	186	503	200	444	172	455	470	242	548	213	405
1917	907	176	521	205	386	148	554	566	322	720	232	437
1918	2697	520	1538	599	1159	443	830	838	428	944	402	749
1919	962	156	518	169	444	143	354	339	201	420	153	271
1920	1030	165	502	163	528	167	363	334	185	347	178	321

BRONCHO-PNEUMONIA.

1905	....	....	....	....	....	....	....	....	....	....	....	....
1906	241	52	122	54	119	50	143	168	71	186	72	152
1907	227	49	123	54	104	43	128	149	64	165	64	135
1908	191	40	92	40	99	41	125	143	65	165	60	125
1909	225	47	122	52	103	42	155	175	73	182	82	169
1910	252	52	114	48	138	56	102	114	50	123	52	106
1911	273	56	137	57	136	55	139	153	77	187	62	125
1912	314	64	152	63	162	65	145	158	77	184	68	135
1913	375	75	191	78	184	73	189	203	92	217	97	191
1914	409	82	198	80	211	83	164	174	92	214	72	140
1915	363	72	172	69	191	75	178	186	89	204	89	171
1916	393	77	192	76	201	78	218	225	102	231	116	221
1917	383	74	215	84	168	65	206	211	112	250	94	177
1918	729	141	411	160	318	121	265	268	102	225	163	304
1919	474	77	257	84	217	70	186	178	109	228	77	137
1920	506	81	242	78	264	83	184	169	95	178	89	160

* The totals of these figures, which were obtained from special tables in the annual reports, do not always correspond with those of the tables of deaths from all causes, but their proportionate distribution by color and sex may be regarded as relatively accurate.

TABLE 74.—*Number of deaths and rate of death, per 100,000 living inhabitants, from pneumonia, bronchitis, etc.*—Continued.

LOBAR PNEUMONIA.

Year.	White.						Colored.					
	Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R
1905	....	....	....	....	....	....	....	....	....	....	....	....
1906	409	88	207	92	202	85	229	270	135	353	94	199
1907	458	98	253	111	205	86	281	326	160	412	121	256
1908	392	83	201	87	191	79	232	266	120	304	112	234
1909	498	104	244	104	254	104	237	268	131	327	106	219
1910	518	107	281	119	237	96	187	209	110	271	77	157
1911	460	94	241	101	219	88	242	266	134	325	108	217
1912	373	76	197	81	176	70	216	235	122	292	94	187
1913	422	85	226	92	196	78	212	227	120	283	92	181
1914	425	85	244	99	181	71	203	215	112	261	91	177
1915	405	80	227	91	178	69	186	195	111	255	75	144
1916	554	109	311	123	243	94	237	245	140	317	97	185
1917	524	102	306	120	218	84	348	356	210	469	138	260
1918	1968	379	1127	439	841	321	565	571	326	719	239	445
1919	488	79	261	85	227	73	168	161	92	192	76	135
1920	524	84	260	84	264	83	179	165	90	169	89	160

BRONCHITIS.

1905	156	34	75	34	81	35	90	108	43	114	47	102
1906	133	29	71	31	62	26	74	87	38	99	36	76
1907	134	29	63	28	71	30	48	56	19	49	29	61
1908	115	24	54	23	61	25	48	55	24	61	24	50
1909	104	22	37	16	67	27	37	42	17	42	20	41
1910	125	26	56	24	69	28	32	36	13	32	19	39
1911	108	22	46	19	62	25	44	48	18	44	26	52
1912	112	23	47	19	65	26	36	39	18	43	18	36
1913	116	23	58	24	58	23	51	55	27	64	24	47
1914	112	22	54	22	58	23	40	42	28	65	12	23
1915	96	19	42	17	54	21	30	31	9	21	21	40
1916	....	....	....	....	....	....	....	....	....	....	....	....
1917	....	....	....	....	....	....	....	....	....	....	....	....
1918	....	....	....	....	....	....	....	....	....	....	....	....
1919	....	....	....	....	....	....	....	....	....	....	....	....
1920	....	....	....	....	....	....	....	....	....	....	....	....

of these rates are so clear that extended discussion is unnecessary. The wide difference in the rates for pneumonia (broncho and lobar combined) in whites and in negroes is striking. The general trend of the curves of these rates follow each other closely; a marked difference occurs in only one year, 1910, when there is a decided dip in the rate for colored, without a corresponding change in the rate for white. The increase in the rate in the influenza year, 1918, is notably greater in whites than in colored.

Similarly, the course of the curves for pneumonia in male and female white and colored shows a remarkably close correspondence, a feature lacking in the curves for bronchitis. The decidedly lower death-rates for pneumonia in females in both races is evident.

When the annual rates for each of these categories is averaged for pneumonia for the period 1906–1920, and for bronchitis for the period 1905–1915, the rates for white and colored stand in the following ratios to each other: Total pneumonia as 1:2.47 (179 to 443); broncho-pneumonia as 1:2.57 (69 to 178); lobar pneumonia as 1:2.40 (110 to 265); and bronchitis as 1:2.19. Thus, under each category the death-rate is greater by two and a quarter to two and a half times in colored than in white.

The averaged rates for the same categories for sex and color show ratios as follows: Total pneumonia, males to females, white 1.17:1 (194 to 166), colored 1.41:1 (526 to 374); broncho-pneumonia, males to females, white 1.08:1 (72 to 67), colored 1.20:1 (196 to 163); lobar pneumonia, males to females, white 1.23:1 (122 to 99), colored, 1.57:1 (330 to 210); and bronchitis, males to females, white 1:1.13 (22 to 26), colored, 1.12:1 (58 to 52). Therefore, pneumonia, both broncho and lobar, is considerably more fatal for males than for females of both races, and bronchitis is somewhat more fatal for white females and for colored males. In like manner, when the totals for the absolute figures for the deaths of whites and negroes during these periods are compared, the ratios are heavily against the negro; total pneumonia, 1.96:1, broncho-pneumonia, 2.12:1, lobar pneumonia, 2.26:1, and bronchitis, 2.47:1, while the proportion of negroes to whites in the population during this period was as 1:5.42.

Death-rates, specific in regard to age for sex and color for the census year 1910, for bronchitis, broncho-pneumonia, lobar pneumonia, and total pneumonia, are shown in table 75. Owing to certain small discrepancies in the official tables and to the forced omission of pleural affections, the absolute figures and the rates under the different categories are not in exact agreement with those presented in previous tables. It is evident from inspection of the

TABLE 75.—*Number of deaths and rate of death, per 100,000 living inhabitants, from bronchitis and pneumonia, according to age, for 1910.*

D = death. R = rate.

TOTAL PNEUMONIA.

Age period.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
Under 1 year.....	231	2256	154	1732	77	1715	77	1749	77	5712	44	6423	33	4962
Betw. 1 and 2 years	101	1051	78	919	42	958	36	878	23	2041	10	1795	13	2281
2 to 4 years.....	94	293	59	211	29	206	30	216	35	842	23	1143	12	560
5 to 9 years.....	22	44	17	39	8	37	9	42	5	78	1	33	4	119
Under 10 years....	448	441	308	348	156	350	152	346	140	1073	78	1235	62	921
10 to 19 years.....	27	26	17	19	11	26	6	13	10	73	5	85	5	63
20 to 29 years.....	52	46	25	27	23	52	2	4	27	131	15	166	12	104
30 to 39 years.....	83	93	53	72	24	67	29	77	30	190	20	261	10	123
40 to 49 years.....	66	96	41	72	24	87	17	57	25	219	14	248	11	192
50 to 59 years.....	99	219	79	202	45	238	34	169	20	330	12	405	8	258
60 to 69 years.....	114	460	93	424	57	577	36	299	21	727	11	833	10	638
70 to 79 years.....	113	1081	105	1110	38	965	67	1214	8	803	2	496	6	1012
80 years and over..	57	2134	49	2063	17	1981	32	2109	8	2703	3	3226	5	2463
Total	1059	190	770	163	395	173	375	153	289	340	160	406	129	282

TABLE 75.—*Number of deaths and rate of death, per 100,000 living inhabitants, from bronchitis and pneumonia, according to age, for 1910.*—Continued.

BRONCHO-PNEUMONIA.

Age period.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
Under 1 year.....	140	1367	95	1069	45	1002	50	1136	45	3338	22	3212	23	3459
Betw. 1 and 2 years	54	562	43	507	27	616	16	390	11	976	5	898	6	1053
2 to 4 years.....	46	143	27	97	12	85	15	108	19	457	11	547	8	373
5 to 9 years.....	10	20	8	19	4	18	4	19	2	31	...	....	2	60
Under 10 years....	250	246	173	195	88	197	85	193	77	590	38	602	39	379
10 to 19 years.....	3	3	1	1	1	2	...	....	2	15	...	....	2	25
20 to 29 years.....	5	4	1	1	...	....	1	2	4	19	2	22	2	17
30 to 39 years.....	5	6	4	5	2	6	2	5	1	6	1	13	...	....
40 to 49 years.....	5	7	2	4	2	7	...	....	3	26	3	53	...	....
50 to 59 years.....	14	31	9	23	4	21	5	25	5	82	3	101	2	64
60 to 69 years.....	24	97	18	82	5	51	13	108	6	208	3	227	3	191
70 to 79 years.....	31	297	28	296	8	203	20	362	3	301	...	....	3	506
80 years and over..	17	636	16	674	4	466	12	791	1	338	...	....	1	493
Total	354	63	252	53	114	50	138	56	102	120	50	127	52	114

LOBAR PNEUMONIA.

Under 1 year.....	91	889	59	664	32	713	27	613	32	2374	22	3212	10	1504
Betw. 1 and 2 years	47	489	35	412	15	342	20	488	12	1065	5	898	7	1228
2 to 4 years.....	48	149	32	114	17	121	15	108	16	385	12	596	4	187
5 to 9 years.....	12	24	9	21	4	18	5	23	3	47	1	33	2	60
Under 10 years....	198	195	135	152	68	152	67	152	63	483	40	634	23	342
10 to 19 years.....	24	23	16	18	10	23	6	13	8	58	5	85	3	38
20 to 29 years.....	47	42	24	26	23	52	1	2	23	112	13	144	10	86
30 to 39 years.....	78	87	49	67	22	62	27	71	29	183	19	248	10	123
40 to 49 years.....	61	89	39	68	22	80	17	57	22	193	11	195	11	192
50 to 59 years.....	85	188	70	179	41	217	29	144	15	247	9	304	6	193
60 to 69 years.....	90	363	75	342	52	526	23	191	15	519	8	606	7	446
70 to 79 years.....	82	784	77	814	30	762	47	852	5	502	2	496	3	506
80 years and over..	40	1498	33	1389	13	1515	20	1318	7	2365	3	3226	4	1970
Total	705	126	518	109	281	123	237	97	187	220	110	279	77	168

BRONCHITIS.

Under 1 year.....	32	313	24	270	8	178	16	363	8	593	4	584	4	602
Betw. 1 and 2 years	11	114	6	71	3	68	3	73	5	444	3	539	2	351
2 to 4 years.....	10	31	8	29	2	14	6	43	2	48	1	50	1	47
5 to 9 years.....	3	6	3	7	1	5	2	9	...	....	...	....	...	....
Under 10 years....	56	55	41	46	14	31	27	61	15	115	8	127	7	104
10 to 19 years.....	5	5	...	....	...	....	...	....	5	36	...	....	5	63
20 to 29 years.....	....	....	...	....	...	....	...	....	...	....	...	....	...	....
30 to 39 years.....	6	7	3	4	3	8	...	....	3	19	2	26	1	12
40 to 49 years.....	5	7	1	2	1	4	...	....	4	35	2	35	2	35
50 to 59 years.....	3	7	3	8	2	11	1	5	...	....	...	....	...	....
60 to 69 years.....	21	85	19	87	13	132	6	50	2	69	...	....	2	128
70 to 79 years.....	30	287	29	307	16	406	13	236	1	100	...	....	1	169
80 years and over..	31	1161	29	1221	7	816	22	1450	2	676	1	1075	1	493
Total	157	28	125	26	56	24	69	28	32	38	13	33	19	42

table that the general course of the curves for bronchitis and both broncho- and lobar pneumonia is similar, and that age has exerted an enormously important influence upon the rates in both whites and negroes. For bronchitis, the lower rates occur in whites between 10 and 50 years and in negroes between 20 and 40 years. For broncho-pneumonia, the lowest death-rates

fall in whites between 20 and 60 years and in blacks between 20 and 50 years. In this affection, as officially classified, the rates show a drop in the third decade in whites and in the fourth decade in negroes, and for bronchitis no deaths are credited to negroes in the third and fourth decades of life. In both of these affections the death-rates are higher under the tenth year in negroes than in whites, while after the seventy-ninth year the reverse is the case. If the rates for bronchitis and broncho-pneumonia were combined, on the whole, the curve of the plotted figures would not depart materially from that for broncho-pneumonia alone.

In lobar pneumonia, as in the other two affections examined, the highest rates are met with at the extremes of age. The rates for negroes are considerably higher than those for whites throughout the life-span. The lowest rates for whites lie between the tenth and the fiftieth year and those for negroes between the tenth and the thirtieth year. The rates for negroes are at all ages uniformly higher than those for whites. In both races there is a little change in the rates between the fourth and fifth decades. While the rates for lobar pneumonia are lower in the earlier years of life, they are higher throughout than those for broncho-pneumonia.

The courses of the combined rates for broncho- and lobar pneumonia show perhaps more accurately the relation of age and race to pneumonia mortality. In bronchitis, the female total rate is significantly higher than the male in whites; the rate for males is greater than that for females in every decade except the first year and for 80 years and over. In the colored, the female rate is 20 per cent higher than the male rate for all ages and for each decade except the first, fourth, fifth, and 80 years and over. There were no deaths in colored males in the second, third, sixth, seventh, and eighth decades. For broncho-pneumonia in whites, the total female rate is 10 per cent greater than the male, but there is very little difference in the rates for the two sexes before the seventh decade, after which the rate in females is markedly higher. In the colored, the total rate is greater in males by 10 per cent and the rates are higher in this sex uniformly until the seventh decade, after which the rates for females are not markedly in excess. In lobar pneumonia the total rate for males is 21 per cent greater than that for females, and the male rate exceeds the female rate in every decade except the fourth and over 70 years. In the negro, the male rate is much higher in the first four decades. In the sixth and seventh decades and 80 years and over, the female rates are higher. In the eighth decade, the rates for the two sexes are equal. For the whole life-span, the male rates are 36 per cent greater than the female. In broncho- and lobar pneumonia taken together for whites, the rate for all ages is 11.5 per cent greater in males, in whom higher rates are met in each decade except the fourth and after 70 years, when the rates for females are considerably higher. In the colored race, the rate for all ages is 30 per cent higher in males, and the rates for the separate decades, except after the seventh, are considerably higher in the male.

The rates for the same categories in 1920 (table 76), which differing in many respects from those for 1910, shows, in the main, very much the same proportional distribution of mortality by age, color and sex.

When on the basis of rates specific for age for the total population, for whites and for negroes, the mortality from all forms of pneumonia and from all

TABLE 76.—*Number of deaths, and rate of death, per 100,000 living inhabitants, from pneumonia and bronchitis, according to age, color, and sex, for 1920.*

D = death. R = rate.

TOTAL PNEUMONIA.

Age-groups.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
Under 1 year.....	275	1852	181	1405	95	1439	86	1369	94	4776	53	5538	41	4055
1 to 4 years.....	174	319	113	235	55	228	58	242	61	952	31	996	30	911
0 to 4 years.....	449	647	294	482	150	488	144	332	155	1851	84	2064	71	1649
5 to 9 years.....	32	50	24	43	14	49	10	36	8	99	6	155	2	48
0 to 9 years.....	481	359	318	271	164	276	154	265	163	991	90	1135	73	858
10 to 19 years.....	41	33	29	27	15	28	14	25	12	75	5	71	7	79
20 to 29 years.....	152	105	106	89	46	78	60	100	46	178	24	197	22	161
30 to 39 years.....	162	132	123	122	67	133	56	112	39	179	19	172	20	186
40 to 49 years.....	129	140	85	111	39	102	46	119	44	283	20	241	24	329
50 to 59 years.....	139	222	112	205	58	217	54	193	27	344	15	353	12	332
60 to 69 years.....	134	372	116	356	60	392	56	325	18	519	5	292	13	742
70 to 79 years.....	108	749	101	773	41	733	60	804	7	516	4	661	3	399
80 years and over.	47	135	40	128	12	599	28	1398	7	1977	3	2239	4	1818
Total	1393	190	1030	165	502	163	528	167	363	334	185	348	178	321

BRONCHO-PNEUMONIA.

Under 1 year.....	230	1549	148	1149	76	1152	72	1146	82	4167	47	4911	35	3462
1 to 4 years.....	127	233	81	168	39	162	42	175	46	718	24	771	22	668
0 to 4 years.....	357	515	229	376	115	374	114	263	128	1528	71	1744	57	1324
5 to 9 years.....	18	28	14	25	8	28	6	22	4	50	3	78	1	24
0 to 9 years.....	375	280	243	207	123	207	120	207	132	803	74	933	58	681
10 to 19 years.....	15	12	13	12	5	9	8	15	2	13	2	28	...	....
20 to 29 years.....	42	29	35	29	18	31	17	28	7	27	1	8	6	44
30 to 39 years.....	32	26	25	25	12	24	13	26	7	32	4	36	3	28
40 to 49 years.....	32	35	20	26	10	26	10	26	12	77	4	48	8	110
50 to 59 years.....	40	64	33	60	15	56	18	64	7	89	4	94	3	83
60 to 69 years.....	58	161	50	154	28	183	22	128	8	231	2	117	6	342
70 to 79 years.....	64	444	60	459	23	411	37	496	4	295	2	331	2	266
80 years and over.	32	92	27	86	8	399	19	949	5	1412	2	1493	3	1364
Total	690	94	506	81	242	78	264	83	184	169	95	178	89	160

LOBAR PNEUMONIA

Under 1 year.....	45	303	33	256	19	288	14	223	12	610	6	627	6	593
1 to 4 years.....	47	86	32	67	16	66	16	67	15	234	7	225	8	243
0 to 4 years.....	92	133	65	107	35	114	30	69	27	322	13	319	14	325
5 to 9 years.....	14	22	10	18	6	21	4	14	4	50	3	78	1	24
0 to 9 years.....	106	79	75	64	41	69	34	59	31	189	16	202	15	176
10 to 19 years.....	26	21	16	15	10	19	6	11	10	63	3	42	7	79
20 to 29 years.....	110	76	71	60	28	48	43	71	39	151	23	189	16	117
30 to 39 years.....	130	106	98	97	55	109	43	86	32	147	15	136	17	158
40 to 49 years.....	97	105	65	85	29	76	36	93	32	205	16	193	16	219
50 to 59 years.....	99	158	79	144	43	161	36	128	20	255	11	259	9	249
60 to 69 years.....	76	211	66	203	32	209	34	197	10	289	3	175	7	400
70 to 79 years.....	44	305	41	314	18	322	23	308	3	221	2	331	1	133
80 years and over.	15	43	13	42	4	200	9	449	2	565	1	746	1	455
Total	703	96	524	84	260	84	264	83	179	165	90	169	89	160

TABLE 76.—*Number of deaths and rate of death, per 100,000 living inhabitants, from pneumonia and bronchitis, etc.*—Continued.

BRONCHITIS.

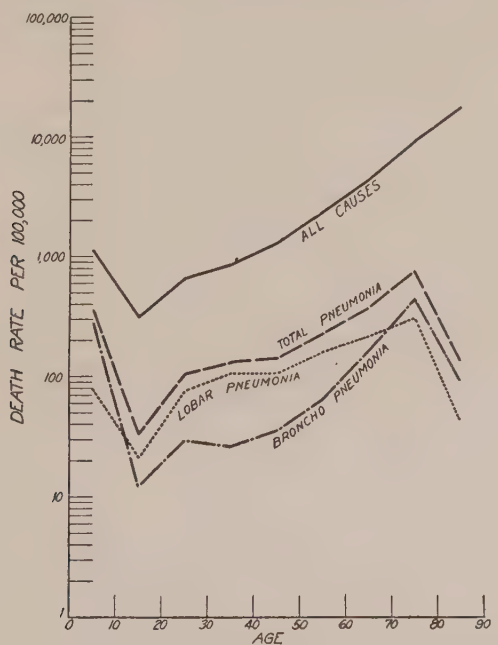
Age-groups.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
Under 1 year.....	34	229	22	171	11	167	11	175	12	610	7	731	5	495
1 to 4 years.....	13	24	6	12	3	12	3	13	7	109	3	96	4	121
0 to 4 years.....	47	68	28	46	14	46	14	32	19	227	10	246	9	209
5 to 9 years.....	2	3	1	2	1	3	...	....	1	12	1	26	...	....
0 to 9 years.....	49	37	29	25	15	25	14	24	20	122	11	139	9	106
10 to 19 years.....	1	1	....	....	...	....	...	....	1	6	1	14	...	....
20 to 29 years.....	1	1	1	1	1	2	...	....	...	....	...	....	...	....
30 to 39 years.....	5	4	4	4	1	2	3	6	1	5	...	....	1	9
40 to 49 years.....	1	1	1	1	...	....	1	3	...	....	...	....	...	....
50 to 59 years.....	2	3	2	4	2	7	...	....	...	....	...	....	...	....
60 to 69 years.....	5	14	4	12	...	....	4	23	1	29	...	....	1	57
70 to 79 years.....	7	49	7	54	3	54	4	54	...	....	...	....	...	....
80 years and over.	13	37	12	38	4	200	8	399	1	282	1	746	...	....
Total	84	11	60	10	26	8	34	11	24	22	13	24	11	20

causes of death in 1920 are compared (tables 76 and 136, graph 20) the shapes of the respective curves from the first to the eighth decade of life are strikingly similar. In all there is the same marked drop in the second decade from the high level of the first, with a decided rise in the third decade. For the total population the rates ascend in much the same degree from the third to the seventh decade of life. The mortality from pneumonia fails to rise, in negroes, between the third to the fourth, and, in whites, between the fourth and fifth decades, and after the seventy-ninth year the pneumonia-rate falls in whites and rises in negroes. With these minor exceptions, however, the parallelism is very close. Remarkably similar agreements exist also in the course of rates specific for sex and age. While the rates for all causes include, of course, those for pneumonia, the latter bear too small a proportion to the whole to seriously vitiate the comparison. It would appear, then, that the risk of dying in the various decades of life from pneumonia varied directly with the risk of dying from some one of all the remaining causes of death, i. e., of dying at all.

But the category all forms of pneumonia consists of at least two very distinctly different elements. Lobar pneumonia differs from broncho-pneumonia (including bronchitis) in two essential features, namely, that it is both etiologically and pathologico-anatomically a specific disease. Broncho-pneumonia represents, on the other hand, a heterogeneous congeries of acute lung infections caused by a variety of pyogenic organisms. Therefore, these two forms of pneumonia must be considered separately. For this purpose their courses in rates specific for age for the whole population are compared with that for all causes of death on graph 20.

It is evident that during the first 10 years of life, though on widely different levels (the mortality from broncho-pneumonia being much higher than that from lobar pneumonia), the rates for both these affections exhibit the characteristics of such acute specific infections as scarlet fever, measles, whooping-cough, and diphtheria. They are both characterized by high rates during the first and by low rates during the second decade of life. Unlike the specific infections above mentioned, both forms of pneumonia show rising rates after

the second decade of life. As between themselves, however, there are marked differences in degree of lethal force. The mortality for broncho-pneumonia is much greater in the first and much less in the second decade than that for lobar pneumonia. The mortality for the latter rises to a higher level in the third decade (when it is nearly as high as in the first) and, except for a standstill between 40 and 49 years, continues to mount by gradual steps up to the eightieth year. With broncho-pneumonia, on the other hand, the rate of mortality, after remaining stationary on a very low level between the thirtieth and forty-ninth years of life, rises comparatively abruptly and in the eighth decade far surpasses that for lobar pneumonia. After the seventy-ninth year of life the mortality for both forms of pneumonia falls notably, but the rate for broncho-pneumonia is more than double that for lobar pneumonia.



GRAPH 20 (from tables 76 and 136). Comparison of mortality-rates specific for age from total pneumonia and from lobar and broncho-pneumonia, and from all causes of death, in 1920.

As compared with the course of the rates for deaths from all causes, broncho-pneumonia conforms more closely during the first 10 years and lobar pneumonia during the remainder of life. In respect to the influence of age upon rate of mortality, therefore, both these two forms of pneumonia depart in a striking manner from the other acute febrile diseases for which local data for comparison exist, and as between each other they present certain marked differences.

Broncho-pneumonia furnishes an example of the influence of age, or rather of the qualities that vary with age, upon the resistance of the lungs to fatal infection with the pyogenic bacteria as a group. This resistance is peculiarly weak in the extremes of life and particularly strong between 5 and 50 years of age. With lobar pneumonia the resistance to death is only relatively weak in the first 5 years of life, high from the fifth to the nine-

teenth year and thereafter steadily and notably decreasing until the eightieth year. In this latter period its course of mortality closely parallels that for all causes of death. In these respects lobar pneumonia is unique among the specific febrile diseases analyzed in this material.

As exposure to pneumonia is in general terms not selective, these phenomena suggest among other things that the forces of natural immunity which participate in the control of mortality from lobar and broncho-pneumonia in the various age-periods differ, in part at least, in their seats or in their modes of action. The fact that the age distribution of mortality from lobar pneumonia follows so closely the path of all causes of death, and therefore seems to be more intimately associated with general constitutional vigor, suggests that for this type of pneumonia natural resistance is mainly general or constitutional rather than local. The in some respects contrary behavior of mortality for the non-specific broncho-pneumonia provokes the suggestion that the chief seat of resistance is local, i. e., in the lungs. These aberrations do not, however, warrant the view that general constitutional resistance plays no part in the one disease and local resistance is unimportant in the other, but they do indicate that as between the two affections there are differences in this regard. It is a significant fact that for lobar pneumonia the relative immunity from death acquired by the individual after passing through infancy and childhood to puberty, a quality which it shares with so many acute specific infections, is, contrary to what obtains with them, no higher in the third than in the first decade, and after this period steadily diminishes during the remainder of life. Of significance also is the behavior of resistance of the individual to death from lung infection with the mixture of pyogenic bacteria concerned with the causation of broncho-pneumonia, as exemplified by the low death-rate between the tenth and the forty-ninth years, with the marked rise into the period of old age.

Pneumonia, both lobar and broncho, was made reportable in 1917, but the reporting of cases has not been complete enough for definite conclusions in regard to case fatality. The cases reported in 1921 were tabulated according to color, sex, and age. While, perhaps, they were not all cases of primary pneumonia, and in number they certainly fall short of actual occurrence (there were only 2,095 cases as compared with 1,001 deaths, and the death certificates were not cross-checked with the cards of reported cases in order to add to the list of the latter individuals recorded as dying of pneumonia but not reported as cases previous to death), their proportional distribution according to these three categories is probably accurate enough to justify comparison of the specific rates presented in table 77.

It will be observed that in their general trend the morbidity-rates for the various categories agree with the corresponding mortality rates for 1920. For all forms of pneumonia and for both lobar and broncho-pneumonia the morbidity-rates of the population at all ages are higher in negroes than in whites and in females than in males of both races. In the first twenty years of life the age distribution of cases also agrees closely in trend with that for deaths in 1920. In the third decade of life morbidity decreases in the white and increases in the negro. There is a gradual rise in the rates in whites during the third and fourth and in negroes from the third

TABLE 77.—*Number of cases and rate of morbidity, per 100,000 living inhabitants, in 1920, from pneumonia, according to age, color, and sex, in 1921*

C = cases. R = rate.

TOTAL PNEUMONIA.

Age-groups.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	C	R	C	R	C	R	C	R	C	R	C	R	C	R
Under 1 year.....	253	1703	201	1560	110	1667	91	1448	52	2642	23	2403	29	2868
1 to 4 years.....	445	816	378	786	204	845	174	726	67	1046	33	1060	34	1032
0 to 4 years.....	698	1006	579	949	314	1021	265	611	119	1421	56	1376	63	1463
5 to 9 years.....	232	360	211	374	128	448	83	298	21	260	13	337	8	190
0 to 9 years.....	930	695	790	673	442	745	348	599	140	851	69	870	71	834
10 to 19 years.....	192	155	159	148	105	199	54	98	33	207	16	226	17	191
20 to 29 years.....	194	134	136	114	78	133	58	96	58	225	35	287	23	169
30 to 39 years.....	185	151	128	127	62	123	66	132	57	261	39	353	18	167
40 to 49 years.....	150	162	105	137	64	168	41	106	45	289	26	314	19	261
50 to 59 years.....	154	246	128	234	71	266	57	203	26	331	12	283	14	387
60 to 69 years.....	146	405	123	378	57	372	66	383	23	664	11	642	12	685
70 to 79 years.....	111	770	102	781	35	625	67	898	9	664	5	826	4	533
80 years and over.	33	95	31	99	12	599	19	949	2	565	...	....	2	909
Total	2095	285	1702	272	926	300	776	245	393	362	213	400	180	325

BRONCHO-PNEUMONIA.

Under 1 year.....	214	1441	170	1319	92	1394	78	1241	44	2236	21	2194	23	2275
1 to 4 years.....	311	571	260	540	134	555	126	526	51	796	25	803	26	789
0 to 4 years.....	525	757	430	705	226	735	204	471	95	1134	46	1130	49	1138
5 to 9 years.....	123	191	109	193	67	234	42	151	14	174	9	233	5	119
0 to 9 years.....	648	484	539	459	293	494	246	424	109	663	55	693	54	634
10 to 19 years.....	66	53	51	47	38	72	13	24	15	94	8	113	7	79
20 to 29 years.....	58	40	43	36	17	29	26	43	15	58	9	74	6	44
30 to 39 years.....	64	52	45	45	15	30	30	60	19	87	13	118	6	56
40 to 49 years.....	60	65	40	52	20	52	20	52	20	128	12	145	8	110
50 to 59 years.....	73	117	56	102	31	116	25	89	17	216	8	188	9	249
60 to 69 years.....	62	172	49	151	23	150	26	151	13	375	6	350	7	400
70 to 79 years.....	73	506	64	490	25	447	39	523	9	664	5	826	4	533
80 years and over.	22	63	20	64	9	449	11	549	2	565	...	....	2	909
Total	1126	153	907	145	471	153	436	138	219	201	116	218	103	186

LOBAR PNEUMONIA.

Under 1 year.....	39	263	31	241	18	273	13	207	8	407	2	209	6	593
1 to 4 years.....	134	246	118	245	70	290	48	200	16	250	8	257	8	243
0 to 4 years.....	173	249	149	244	88	286	61	141	24	287	10	246	14	325
5 to 9 years.....	109	169	102	181	61	213	41	147	7	84	4	104	3	71
0 to 9 years.....	282	211	251	214	149	251	102	176	31	189	14	177	17	200
10 to 19 years.....	126	102	108	100	67	127	41	75	18	113	8	113	10	113
20 to 29 years.....	136	94	93	78	61	104	32	53	43	166	26	213	17	125
30 to 39 years.....	121	99	83	83	47	93	36	72	38	174	26	235	12	111
40 to 49 years.....	90	97	65	85	44	115	21	54	25	161	14	169	11	151
50 to 59 years.....	81	129	72	132	40	150	32	113	9	115	4	94	5	138
60 to 69 years.....	84	233	74	227	34	222	40	232	10	289	5	292	5	285
70 to 79 years.....	38	264	38	291	10	179	28	375	...	....	...	....	...	....
80 years and over.	11	32	11	35	3	150	8	399	...	....	...	....	...	....
Total	969	132	795	127	455	148	340	107	174	160	97	182	77	139

to the sixth decade, inclusive. The rate in the white ascends sharply in the sixth, seventh, and eighth decades, and in the negro in the seventh decade. In the latter there is little change in the level of the rate after the sixty-ninth year, while in the white the rate falls sharply after the seventy-ninth year of life; morbidity is considerably higher in the negro at every age-period up to the eightieth year, but the difference is most marked between the thirtieth and the fiftieth years.

Among whites the incidence of pneumonia is higher in males than in females in every age-period except the fourth decade and after the sixty-ninth year, while in the negro it is higher in males throughout life except in the sixth, seventh, and eighth decades. This disparity between the rates for males and females is greatest among whites in the first three decades and among negroes in the third, fourth, and eighth decades.

It is notable that while the difference in incidence for broncho- and lobar pneumonia in the population as a whole at all ages is not great, the rates being 153 and 138, respectively, the proportional distribution of morbidity relative to the different age-groupings varies widely. In both the rates of morbidity are considerably higher in negroes than in whites and in males than in females of both races. As with the mortality in 1920, the morbidity-rate for broncho-pneumonia in 1921 is very high in the first decade. It recedes, however, sharply in the second, falls still lower in the third, and remains relatively low during the fourth and fifth decades. After the forty-ninth year the rate of incidence rises steadily to a peak in the eighth decade and then falls abruptly during the remainder of life. In every age period the rate is considerably higher among negroes than among whites. Among the latter the rate for males exceeds that for females in the first, second, sixth, and eighth decades and eighty years and over, while in the third, fourth, and fifth decades the case is reversed. Among negroes the rate of incidence is higher in males, except in the sixth and seventh decades.

For lobar pneumonia in the population as a whole, from a relatively high level for the first decade of life, the morbidity-rate falls markedly in the second then slightly again to its lowest point in the third decade. There is but little fluctuation in the rate in the 30 years between the twentieth and the forty-ninth years of age. After the fiftieth year the rise in morbidity is gradual and the peak is attained in the eighth decade, after which the rate declines sharply. In general trend the course of the rate for whites departs but slightly from that of the total rate. In the negro the course of recorded morbidity shows distinct differences. Somewhat lower in the first two decades of life than the rate for whites, it ascends abruptly in the third decade to a relatively high level, which is maintained with little deviation until the fiftieth year of life. The rate falls in the sixth decade to the level of the second, but rises again in the seventh. No cases were reported among negroes over the sixty-ninth year of age.

Among whites the rate is higher in males than in females until the sixty-ninth year, after which the reverse is true. The rates for the two sexes, however, follow in general the same trend. Among negroes the rate is higher for males than for females in every decade except the first, sixth, and seventh. But in the third, fourth, and fifth decades the trends of the two

are quite different. The male rate runs to a high peak in the third and fourth decades, and then falls in the fifth and sixth decades, to rise again in the seventh. The rate for negro males is nearly as high in the fourth as in the first decade. These irregularities in the course of the rates for negroes are probably in large degree the result of inadequate case reporting.

In the main, however, the striking differences in the trends of the rates for broncho- and lobar pneumonia observed in connection with mortality are reflected in the morbidity-rates as well. In so far as may be judged from this material, it would appear that in lobar pneumonia the risk of contracting the disease varies hardly at all between the nineteenth and the forty-ninth years, while the risk of dying from it rises progressively between the twentieth and thirty-ninth years, remains unchanged between the fortieth and forty-ninth years, and thereafter increases with much the same proportion as does morbidity. With broncho-pneumonia, on the other hand, except in the second decade of life, the risks of incidence and of death in the various age-groups follow the same trend in all the age-groups.

On the whole, the trends of morbidity-rates specific for age, color, and sex for total pneumonia, and for lobar and broncho-pneumonia separately, in 1921 follow closely those of the corresponding rates for mortality in 1920. The agreement in respect to the variation with age of the qualities which control resistance to lobar and broncho-pneumonia and the specific differences in natural immunity of individuals toward these two kinds of acute lung infection support the implications in these regards derived from the study of mortality alone.

SUMMARY.

The curve for total annual mortality-rates from the acute inflammatory affections of the respiratory tract (table 60, graph 17) is marked throughout most of its course by rather wide fluctuations. Some of these are short and cover only from one to three years, while others extend over a long sweep of years. The first are particularly common before 1840, and are usually associated with corresponding variations in the rates for each member of the group. They are particularly wide for whooping-cough. The second type occurs when, owing to the gradually diminishing importance of the latter disease and the steadily rising rates for diphtheria and pneumonia, the curve for the total rates tends to grow smoother.

Two distant, though irregular, waves in the curve for the total rate appear before 1840. The first, beginning in 1812, reached a peak with a rate of 449 in 1816, and declined to a low level with a rate of 95 in 1831. The second, starting in 1832 and with its peak of 273 in 1833, subsided in 1840 to a rate of 116. The next year the curve for the total rates again began to ascend and by 1848 had reached 315.

From this level the departure was very slight until after 1875. By 1882 the rate had reached 478, and from this point there was a gradual decline to 253 in 1889. Between 1891 and 1903 the total rate was almost constantly above 300 and in several years surpassed 375. Then there was a gradual descent to lower levels, but never under 200, until 1918, when in connection with the influenza—pneumonia epidemic and some increase of the whooping-cough rate, the total

rate rose to 658. The next year, however, the rate fell to 222. After 1885, the shape of the curve of the total rates was in ever-increasing degree determined by the rates for pneumonia.

It is, however, from the curve of the rates as averaged for 5-year periods (table 61, graph 18) that the clearest picture of the course of these affections is obtained. Starting with a rate of 318 in 1812–1815 and declining slightly by 1820, the total rate dropped decidedly in 1821–1825 to 171. Five years later it had fallen to 152, the lowest level ever attained. This fall was due to declines in the rates for each member of the group. From 1835 the total rate ascended by gradual steps to 309 in 1851–1855. This change was brought about entirely by increases in the rates for pneumonia and diphtheria; the rate for whooping-cough was practically stationary. After falling slightly during the next 10 years, due to a sharp decline in the diphtheria rate, the total rate rose gradually to its highest level, 418, in 1881–1885. This was associated with an almost unbroken rise in the pneumonia rate and a sudden and great rise in that for diphtheria during the last 10 years. In 1881–1885 the rates for each of these two diseases stood almost at the same level, i. e., about 200. By 1880, the rate for whooping-cough had declined conspicuously, and in 1881–1885 was only 21. Due to an abrupt fall in the rates for diphtheria and whooping-cough, which more than overbalanced the steady rise in the pneumonia rate, the total rate declined to 319 in 1886–1890. Its rise to 363 in 1891–1895 was owing entirely to the continued ascent in the pneumonia rate. From this level the rate declined continuously to 244 in 1911–1915. During these 20 years the rates for all the members of the group fell decidedly, though not always at the same time. Owing almost entirely to a rise in the pneumonia rate, the total rate rebounded to 332 in 1916–1920. The total rate, therefore, fell continuously and decidedly between 1812 and 1830 from a high to a very low level. During the succeeding 55 years the rate rose to its highest peak in 1881–1885, and from this point declined, with but one interruption, until 1911–1915.

From this detailed account of the behavior of this group of diseases, certain important considerations are evident. No attempts at artificial interference with the progress of pneumonia have ever been made in Baltimore. Such attempts of this nature against whooping-cough as have been made during the past 20 years have proven fruitless. It has been shown that coincidently with the use of improved methods of treatment (intubation about 1890 and antitoxin since 1897, particularly since 1900), the mortality-rate from diphtheria has fallen markedly. Therefore, the courses run by pneumonia and whooping-cough for 108 years and for diphtheria for 78 years reflect fairly accurate pictures of their natural reaction on this population. Here is another clear-cut example over a long period of the reaction of an organ system to its most serious acute infective diseases. After a century of experiment, it ends up as concerns the group as a whole no better than it began, i. e., with death-rates at about the same level. Since their mortality-rates have differed widely during this time, it is evident that either the lethal force of each or the character of the natural resistance of the population, or both, have varied not once but several times.

How much these changes in the courses of mortality were due to variations in the virulence of the organisms, to the differences in the resistance of the

various race stocks present in the population at different times, to the changes in the age distribution of those exposed, and to the modification in the environment, it is difficult to estimate with accuracy.

Concerning one member of this group, whooping-cough, this question can be answered with some degree of definitiveness. The lethal force of this disease, after exhibiting a considerable accession between 1812 and 1820, had, by 1825, sunk to its previous level, and from this time it varied only within comparatively narrow limits until 1880. During this period of 68 years very profound changes in the population and in the environment had occurred. From 1880 to 1900, also a period of considerable changes in the environment, its lethal force sank to a yet lower level, about which it has tended to stabilize, in a population whose racial composition underwent notable changes. Since 1825, the mortality-rates of whooping-cough have varied for only a short period between 1860 and 1870, directly with those of pneumonia, its most important lethal complication. No variety of medical treatment has been shown to influence either the duration or the severity of the disease. Therefore, as it appears that the variations in the lethal capacity of whooping-cough are not directly correlated with changes in population composition, modifications of the environment, or medical treatment, the evidence at hand goes to show that they must lie primarily in modifications in its specific cause. From considerations already brought forward, it would appear that with decrease in lethal force, the disease has made decided gains in invasive capacity.

Under the same conditions, the course of mortality for diphtheria followed very much the same course as whooping-cough until 1845. For the next 20 years, in association with very definite changes of both population and environment, the lethal force of diphtheria increased markedly. In the 10 years from 1866 to 1875 the mortality sank decidedly, only, however, to rise in the next 10 years to an unprecedented level. Its abrupt fall between 1885 and 1890, to a level held for the succeeding 10 years, during a period of considerable change in the population composition, was as striking as the previous rise. As intubation can hardly be held responsible for more than a small part of the change in the mortality-rates during the last phase, the period of untrammeled course for diphtheria may for practical purposes be taken as 88 years. As the course of this disease has often varied directly with changes in the population composition and the environment, variations of its lethal force can not be ascribed wholly to modifications in its causal agent. The fact that diphtheria mortality-rates have varied widely from time to time (associated often with the presence or absence of epidemics) in countries with fairly homogeneous populations and in rural districts where population changes of this type have been gradual or even absent and where environmental conditions tend to remain constant, suggests that variability in the virulence of *B. diphtheriæ* has been the chief cause of variations in the mortality-rates. It is well established by laboratory observation and experiment that the virulence of *B. diphtheriæ* often changes under the influence of a variety of modifications of environment, but the conditions under which it is grown are too highly artificial to warrant too close a comparison with what occurs under natural conditions.

With the acute pulmonary diseases, with their diversities of etiology and pathology, the case is more complicated. Certain it is that having fallen to a low level by 1830, the rate rose strikingly from 1845 to 1855, during a period of rapid and fundamental changes in population and environment. However, it fell as markedly during the next 10 years without any considerable change in either. From 1865 to 1895 the progress of the mortality-rate was steadily upward, and from 1895 to 1910 it was as steadily downward, in face of decided population changes in both periods. With no particular changes in the race composition of the population and greater changes in the environment that previous years had witnessed, the rate was stationary from 1910 to 1915, and then rose sharply in the last 5-year period. From this picture it would appear that whatever the influence of other factors, the changes in the mortality-rates from the pneumonia diseases are not independent of variations in the virulence of one or more of their causal agents.

Among the factors responsible for the fall in mortality from diphtheria since 1880 are the decline in the proportion to the total population of age-group 0 to 9 years and the striking decrease in the susceptibility of the negro as compared with the white. Similarly, much of the decrease in the mortality from whooping-cough since its high level in 1860–1870 is associated with a decline in the proportional relations in the population of this same age-group and of the negro, in whom the disease is peculiarly fatal.

With pneumonia the relation of changes in the age-groupings and of the proportion of negroes to whites in the population to mortality is a much more complex question, because of lack of knowledge of the relative frequency of lobar and broncho-pneumonia in the past and because both forms of pneumonia are particularly fatal in both extremes of life. Since 1850, the proportions of individuals in the population in both early life, when mortality is high, and between ages 10 and 39, when it is comparatively low, have declined, but that above age 39, when mortality rapidly increases to old age, has risen markedly.

TUBERCULOSIS.

Under the title consumption, pulmonary tuberculosis appeared in the table of interments in 1812 as an important cause of death, with 252 out of a total of 1,184 deaths, or 21 per cent or over 1 in 5 of all deaths, and under one or the other of these titles the disease can be followed in each subsequent year. Under this rubric have been included in the present study also deaths assigned to pulmonary hemorrhage and laryngeal tuberculosis. While it is probable that, in the early days, the diagnosis of lethal pulmonary tuberculosis was made with a fair degree of accuracy, particularly in cases of ordinary duration, it is likely that deaths classified under this rubric included some deaths from chronic non-tuberculous pneumonia and empyema, tumors of the lungs and of the mediastinal structures, and that some deaths, especially from the acute types of pulmonary tuberculosis, were classified under other headings.

Under the heading "other forms of tuberculosis" have been assembled deaths attributed in the tables of interments to scrofula, Potts's disease, caries of the vertebræ, disease of the hip and spine, white swelling, and tuberculous meningitis, until the adoption of the international classification in 1899 and, since that date, all deaths assigned to tuberculosis of other organs

than the lungs and larynx. In the early years a considerable number of deaths were attributed to scrofula. Of the total of 215 deaths credited in 1875 to meningitis, cerebro-spinal meningitis, and tuberculous meningitis, 83 were ascribed to the latter cause. It is likely that until 1899 many of the deaths classified under dropsy of the head, hydrocephalus, convulsions, and marasmus were really due to tuberculosis. There must have been a considerable number of deaths due to generalized miliary tuberculosis and tuberculous peritonitis classified under other headings. It seems certain, therefore, that throughout the nineteenth century the total number of deaths due to "other forms of tuberculosis" was much larger than the actual figures indicate.

The incentive that has come into existence during the past 20 or 25 years, on account of the exclusive clauses in insurance policies of a certain type, to conceal deaths from tuberculosis by reporting them under other rubrics, has unquestionably resulted in willful falsification of the returns to a certain extent. Typhoid fever, malaria, chronic bronchitis, and pneumonia have been the chief rubrics of classification of such deaths. As a matter of fact, chronic bronchitis since 1899 (table 60) is the only one of these rubrics to which any considerable number of deaths from pulmonary tuberculosis could have been credited. Were all the deaths from this cause since 1899 assigned to pulmonary tuberculosis, which is by no means warranted, the annual rates for the latter would be raised somewhat, but the general trend of the curve of mortality would not be materially changed. Counterbalancing this source of error, on the other hand, are to be taken into account the consistent efforts put forth in the health department to obtain greater accuracy in the certification and classification of causes of death, and the fact that newer methods of diagnosis and better medical training have tended to render the diagnosis of tuberculosis more certain.

The establishment of sanatoria in the last 14 years without the city limits for the reception of cases of pulmonary tuberculosis has exerted in a very direct way a decidedly favorable influence upon the official death-rates from this affection. During the 8 years 1913 to 1920 there were in the three larger sanatoria within the state (Sabillasville, Eudowood, and Jewish Home for Consumptives) 811 deaths from pulmonary tuberculosis among patients sent from Baltimore City. These individuals would have died within the city and their deaths would have been recorded in the official figures for the latter had these sanatoria not been in existence. When this number is added to the total number of deaths from pulmonary tuberculosis recorded within the city during these 8 years, it is evident that by this change of location for the act of death the official figures for deaths from this affection have been made to undergo a reduction of at least 9 per cent [811 ÷ 9,764 (i. e., 8,953 + 811) = 9.06 per cent]. In other words, by charging deaths of Baltimore citizens temporarily domiciled for treatment in extra-urban sanatoria against the counties in which the latter are situated, instead of against the city in which they became ill and were registered as cases, a purely fictitious reduction of 9 per cent in the number of deaths from pulmonary tuberculosis in Baltimore has resulted. As all of these 811 individuals were white, this apparent and quite artificial decrease in the number of deaths in this race from pulmonary tuberculosis in this period was 12.5 per cent (811 ÷ 6,503 = 12.5 per cent) (table 85). This practice has exerted a marked influence upon the death-rates

for tuberculosis. These deaths thus transferred were not counterbalanced by deaths of tuberculosis within the city of non-residents, which in 1917, a typical year, was only 23, a number far less than the probable number of deaths of citizens of Baltimore in places other than these 3 sanatoria. Indeed, during the last 20 years considerable numbers of individuals with tuberculosis who otherwise would have died in the city have moved to the nearby suburban districts on the advice of physicians.

The annual mortality-rates for pulmonary, other forms, and all forms of tuberculosis are given in table 78 and graph 21. The rates for pulmonary tuberculosis often show rather wide fluctuations, not only from year to year, but over terms of years. Starting with the unusually high rate of 616 in 1812, and falling below 500 in only 4 of the following 10 years, the rates fell from 557 in 1821 to 278 in 1824. Reacting the next year to 416, they fell gradually to 323 in 1829. Ascending to 437 in 1832, the rates had declined to 298 in 1836, and after another short upward turn to 362 in 1838, they fell to 297 in 1840. During the next 14 years the rates rose, except for a slight recession in 1850, continuously to 506 in 1854. From this point, but with some irregularity, they descended to 326 in 1867. With slight annual fluctuations the rates again gradually rose to 381 in 1876, and then fell by gradual steps to 273 in 1889. After a slight reaction to 292 in 1890, there was a gradual decline during the following years to 197 in 1899: With a gradual ascent to 257 in 1904, there was an irregular decline to 183 in 1915. Then by even steps the rates rose to 206 in 1918, but fell to 143 in 1919 and to 128 in 1920. The annual rates for other forms of tuberculosis, while in general low, varied rather widely between 1812 and 1874. In 1812, 1815, 1817, 1818, 1819, and 1829, no deaths were registered under the headings composing this rubric. During the remaining years, the rates varied from the lowest, 1, in 1826 to the highest, 19, in 1822. Rates as high as 8, 10, 12, and 13 occurred in a few years. In 1875, due very largely to the recognition of tuberculous meningitis in the nosological classification, the rate jumped to 60. From this date the rates declined gradually, but by irregular steps, to 20 in 1898. The rate rose abruptly to 50 in 1899, and after registering 42 in 1900 and 46 in 1901, it fell to 22 in 1902. The rate ascended during the next 3 years, and in 1905 stood at 39. It gradually fell to 28 in 1910. Reacting again to 39 in 1911, it fell continuously to 32 in 1917. Rising to 36 in 1918, the rate fell to 30 in 1919 and to 23 in 1920. Since the striking rise in the rate for this rubric in 1875, rates lower than 23 were attained in 1891, from 1893 to 1898, inclusive, and in 1902.

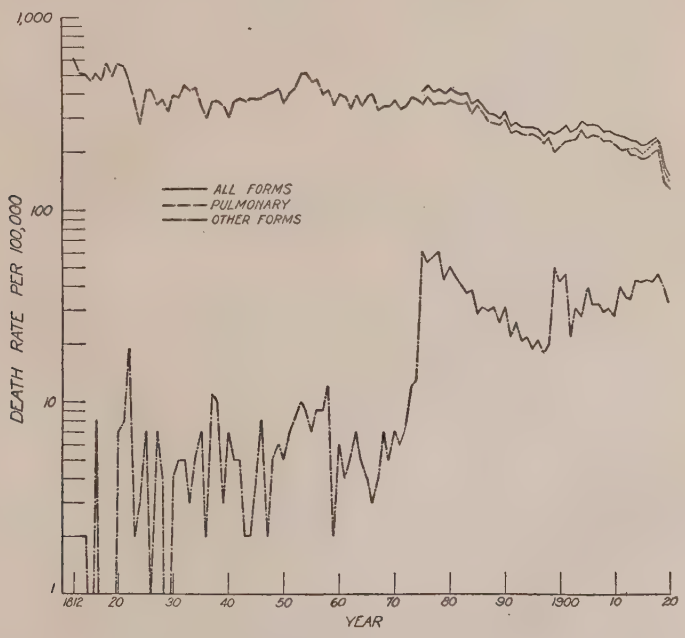
Before 1875, for obvious reasons, the rates for all forms of tuberculosis were but slightly higher than those for pulmonary tuberculosis. With the rise in the former and the fall in the latter after this date the curves for the two gradually separate. From the high level of 434 in 1876, the rate for all forms declined to 259 in 1896, and after reacting to 285 in 1904, receded by gradual steps to 214 in 1915. During the next 3 years the rate rose to 242 in 1918, and fell precipitously to 173 in 1919 and to 151 in 1920.

A very clear idea of the course of tuberculosis in Baltimore is obtained from study of death-rates for pulmonary, other forms, and all forms of the disease averaged for 5- and 10-year periods (table 79, graphs 22 and 23).

TABLE 78.—*Number of deaths and rate of death, per 100,000 living inhabitants, from all forms of tuberculosis, pulmonary tuberculosis, and other forms of tuberculosis, from 1812 to 1920, inclusive.*

D = death. R = rate.

Year.	Tuberculosis.						Year.	Tuberculosis.						Year.	Tuberculosis.					
	All forms.		Pulmonary.		Other forms.			All forms.		Pulmonary.		Other forms.			All forms.		Pulmonary		Other forms.	
	D	R	D	R	D	R		D	R	D	R	D	R		D	R	D	R	D	R
1812	252	616	252	616	...	...	1849	678	426	668	419	10	6	1885	1382	369	1284	343	98	29
1813	219	512	218	509	1	2	1850	589	359	581	354	8	5	1886	1319	345	1202	315	117	31
1814	226	505	225	503	1	2	1851	690	409	679	403	11	7	1887	1224	314	1109	285	115	30
1815	218	466	218	466	...	...	1852	741	427	728	420	13	8	1888	1306	311	1176	280	130	31
1816	254	520	250	512	4	8	1853	910	510	893	501	17	10	1889	1282	295	1168	273	114	26
1817	239	469	239	469	...	...	1854	944	515	928	506	16	9	1890	1402	323	1269	292	133	31
1818	306	575	306	575	...	...	1855	869	462	856	455	13	7	1891	1192	270	1096	248	96	22
1819	273	492	273	492	...	...	1856	916	474	898	464	18	9	1892	1261	281	1146	255	115	26
1820	332	574	328	567	4	7	1857	797	411	779	392	18	9	1893	1213	266	1117	245	96	21
1821	341	565	336	557	5	8	1858	863	424	838	411	25	12	1894	1231	265	1127	243	104	22
1822	308	490	296	471	12	19	1859	728	348	723	346	5	2	1895	1247	265	1156	245	91	19
1823	238	364	237	362	1	2	1860	852	397	839	391	13	6	1896	1242	259	1140	238	102	21
1824	191	281	189	278	2	3	1861	848	386	840	382	8	4	1897	1150	237	1061	218	89	18
1825	300	424	295	416	5	7	1862	759	337	747	331	12	5	1898	1252	254	1154	234	98	20
1826	307	417	306	415	1	1	1863	913	395	896	388	17	7	1899	1236	247	987	197	249	50
1827	272	355	267	349	5	7	1864	825	348	812	343	13	5	1900	1289	254	1077	212	212	42
1828	298	375	295	371	3	4	1865	940	387	931	384	9	4	1901	1393	271	1158	225	235	46
1829	267	323	267	323	...	...	1866	984	396	977	393	7	3	1902	1300	250	1188	228	112	22
1830	335	391	332	388	3	4	1867	839	330	829	326	10	4	1903	1378	261	1216	231	162	31
1831	344	387	340	383	4	5	1868	903	347	885	340	18	7	1904	1524	285	1375	257	149	28
1832	408	443	403	437	5	5	1869	922	346	908	341	14	5	1905	1471	272	1261	233	210	39
1833	397	416	394	413	3	3	1870	1016	373	997	366	19	7	1906	1492	273	1317	241	175	32
1834	424	429	419	424	5	5	1871	940	337	922	331	18	6	1907	1495	270	1317	238	178	32
1835	351	343	344	336	7	7	1872	990	347	970	340	20	7	1908	1414	253	1250	223	164	29
1836	318	300	316	298	2	2	1873	1135	389	1099	377	36	12	1909	1440	254	1273	225	167	30
1837	408	372	396	361	12	11	1874	1147	385	1107	371	40	13	1910	1396	244	1234	216	162	28
1838	421	371	410	362	11	10	1875	1243	408	1061	348	182	60	1911	1388	240	1165	201	223	39
1839	400	342	397	339	3	3	1876	1350	434	1186	381	164	53	1912	1393	238	1189	204	204	35
1840	367	303	359	297	8	7	1877	1285	404	1104	347	181	57	1913	1341	227	1138	193	203	34
1841	456	365	450	360	6	5	1878	1346	414	1150	354	196	60	1914	1344	226	1145	192	199	33
1842	486	377	480	372	6	5	1879	1328	400	1184	351	144	43	1915	1290	214	1098	183	192	32
1843	486	365	483	363	3	2	1880	1413	417	1243	367	170	50	1916	1321	218	1121	185	200	33
1844	513	374	510	372	3	2	1881	1384	400	1227	355	157	45	1917	1407	230	1213	198	194	32
1845	530	375	525	371	5	4	1882	1379	391	1235	350	144	41	1918	1493	242	1273	206	220	36
1846	559	383	548	376	11	8	1883	1432	398	1300	361	132	37	1919	1245	173	1029	143	216	30
1847	593	395	590	393	3	2	1884	1281	349	1143	311	138	38	1920	1107	151	936	128	171	23
1848	629	407	621	401	8	5														



GRAPH 21 (from table 78). Annual crude mortality rates from all forms, pulmonary, and other forms of tuberculosis, from 1812 to 1920 inclusive.

Considering first the rates averaged for 5-year periods, it will be noted that for all forms and for pulmonary tuberculosis, owing to the relatively very small contribution to the total made by other forms until 1875, the two curves, running a parallel course, closely approximate each other from 1812 to 1875. For the next 10 years, owing to a high peak during this period for other forms, the curve for all forms shows a correspondingly sharp rise, while that for pulmonary tuberculosis is almost smooth. After 1885, the descent in both curves is rapid and almost parallel, until 1900. Remaining practically stationary at 525 between 1812 and 1820, the averaged rate for all forms fell to 425 in 1825 and to 372 in 1830. For the period ending in 1835 the rate rose to 403, but for the succeeding 5 years fell to 338. Rising steadily for the next 15 years to 465 between 1851 and 1855, the rate declined by gradual steps to 358 between 1866 and 1870. An ascent during the next

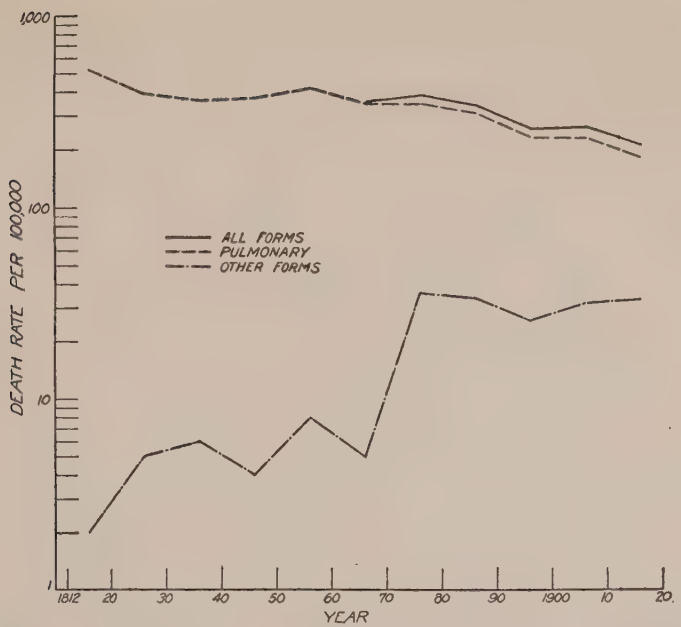
TABLE 79.—*Average rate of death, per 100,000 living inhabitants, by 5- and 10-year periods, from all forms of tuberculosis, pulmonary tuberculosis, and other forms of tuberculosis, from 1812 to 1920, inclusive.*

Periods.	All forms.		Pulmonary.		Other forms.		Periods.	All forms.		Pulmonary.		Other forms.	
	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.		By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.
1812-15	525	...	524	...	1	...	1866-70	358	364	353	359	5	5
1816-20	526	526	523	523	3	2	1871-75	373	...	353	...	20	...
1821-25	425	...	417	...	8	...	1876-80	414	394	360	357	53	36
1826-30	372	399	369	393	3	5	1881-85	382	...	344	...	38	...
1831-35	403	...	398	...	5	...	1886-90	318	350	289	317	30	34
1836-40	338	371	331	365	6	6	1891-95	269	...	247	...	22	...
1841-45	371	...	368	...	3	...	1896-1900	250	260	220	234	30	26
1846-50	394	382	389	378	5	4	1901-05	268	...	235	...	33	...
1851-55	465	...	457	...	8	...	1906-10	259	263	228	232	30	32
1856-60	411	438	401	429	8	8	1911-15	229	...	195	...	35	...
1861-65	371	...	365	...	5	...	1916-20	203	216	172	183	31	33

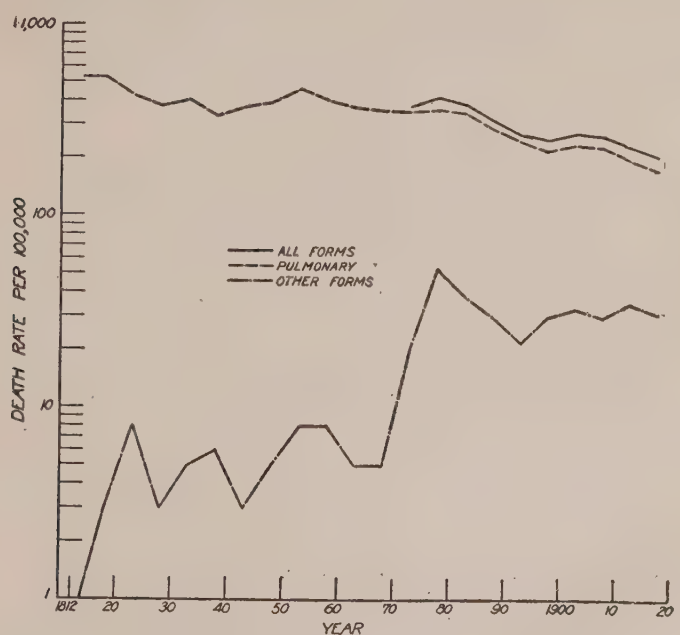
10 years culminated in an average rate of 414 in the 5-year period ending in 1880. From this level the averaged rates declined uninterruptedly to 250 in 1896–1900. After a slight reaction to 268 in 1901–1905, the rates declined gradually to 203 in 1916–1920.

The death-rate for pulmonary tuberculosis was practically constant at 524 from 1812 to 1820, when, by an abrupt descent in 10 years, it fell 33 per cent to 369. Rising to a rate of 398 in 1831–1835, it descended by 1840 to the relatively low rate of 331. From this point there was a wave covering 30 years, with its peak in 1855 with a rate of 457, and falling off in 1866–1870 to a rate of 353, from which it hardly deviated during the following 15 years. Between 1881 and 1885 there was a minor drop in the averaged rate, and between the latter date and 1900 the rate fell to 220, to rise again in 1901–1905 to 235. In 1906–1910 it had fallen to 228, and during the last 10 years the fall was again steep, but not so abrupt as between 1885 and 1900, to 172.

After 1885 the curve of the rates for all forms, brought up by the increase in the rates for other forms since 1875, follows the same general course of



GRAPH 22 (from table 79). Crude mortality rates from all forms, pulmonary, and other forms of tuberculosis, averaged by 5-year periods, from 1812 to 1920, inclusive.



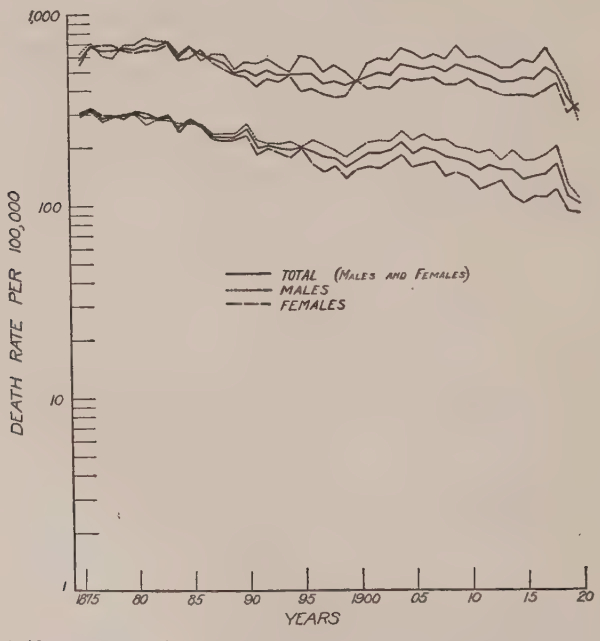
GRAPH 23 (from table 79). Crude mortality rates from all forms, pulmonary, and other forms of tuberculosis, averaged by 10-year periods, from 1812 to 1920, inclusive.

that for pulmonary tuberculosis. Because the rate for other forms contributes such a relatively small quota to the total rate, and since 1900 it has stabilized around a relatively low level, its effect upon the rate for all forms is readily absorbed. During the last 20 years it has averaged about 30.

Turning to the rates averaged for 10-year periods, the curves are of course much smoother. The low point for the first wave for pulmonary tuberculosis is between 1831 and 1840, a drop to 365 from a rate of 523 in 1812–1820. By 1860 the rate had ascended to 429. Following a fall between 1861 and 1870 to 359, the averaged rate remained nearly constant during the next decade, after which it fell steadily during 1891–1900 to 234. Falling but slightly during the next 10 years, it dropped to 183 for the decade 1911–1920.

Viewed from any standpoint, it is very clear from these sets of curves that, on the whole, the death-rate for tuberculosis in the local population has undergone a remarkable drop between 1812 and 1920. The dotted lines on graph 21 indicate the difference in the course of the curves made by correcting the official rates by the "true rates" (table 85) calculated after the addition of the deaths from pulmonary tuberculosis at sanatoria to figures for the deaths occurring within the city. From these it is clear that the descent in the rates that had occurred since 1905 is by no means as great as would appear from the uncorrected figures, and that even from the official rates the angle of fall in this period is by no means so acute as those of the decided falls which began after 1820 and 1885.

The influence of race, as determined by color, upon the death-rates from tuberculosis has been conspicuous. The figures for the annual number of deaths among whites and negroes are available for pulmonary tuberculosis since 1875 and for other forms of tuberculosis as a group since 1900 (table 80 and graph 24). The rates for negroes under both of these headings and in



GRAPH 24 (from table 80). Annual mortality rates, specific for color and sex, from pulmonary tuberculosis from 1875 to 1920, inclusive.

TABLE 80.—*Number of deaths and rate of death, per 100,000 living inhabitants, from pulmonary tuberculosis, other forms of tuberculosis, and all forms of tuberculosis, from 1875 to 1920, inclusive, according to color and sex.*

PULMONARY TUBERCULOSIS.

D = death. R = rate.

Year.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1875 ..	1040	341	767	298	364	292	403	303	273	580	124	627	149	546
1876 ..	1167	375	837	318	398	313	439	323	330	687	143	707	187	673
1877 ..	1094	344	771	287	358	275	413	297	323	659	126	608	197	696
1878 ..	1127	347	803	292	386	291	417	294	324	647	125	589	199	690
1879 ..	1162	350	822	293	406	299	416	287	340	666	150	691	190	647
1880 ..	1221	361	878	306	416	300	462	312	343	658	154	693	189	632
1881 ..	1206	349	839	287	376	266	463	306	367	691	170	748	197	647
1882 ..	1217	345	849	284	406	281	443	287	368	679	168	723	200	646
1883 ..	1272	353	881	289	411	279	470	299	391	707	171	719	220	698
1884 ..	1126	311	792	255	402	268	390	243	334	592	150	617	184	574
1885 ..	1270	339	888	280	430	281	458	280	382	664	192	772	190	582
1886 ..	1204	315	843	261	416	266	427	256	361	616	144	567	217	654
1887 ..	1100	283	751	228	373	234	378	222	349	584	161	620	188	557
1888 ..	1165	278	810	228	403	237	407	219	355	557	171	613	184	514
1889 ..	1147	269	827	228	412	238	415	220	320	493	145	510	175	481
1890 ..	1249	287	914	248	469	266	445	232	335	508	162	559	173	468
1891 ..	1073	243	755	201	396	220	359	184	318	474	162	548	156	415
1892 ..	1127	251	780	205	388	212	392	198	347	508	173	575	174	455
1893 ..	1099	241	767	198	390	210	377	187	332	478	161	525	171	441
1894 ..	1106	238	766	195	405	214	361	177	340	482	154	493	186	472
1895 ..	1141	242	794	199	386	201	408	197	347	483	190	597	157	392
1896 ..	1122	234	771	190	429	219	342	163	351	481	188	581	163	401
1897 ..	1047	216	731	178	411	207	320	150	316	426	161	489	155	376
1898 ..	1061	215	731	175	385	191	346	160	330	438	179	534	151	361
1899 ..	987	197	666	157	365	178	301	138	321	419	166	487	155	365
1900 ..	1077	212	739	172	401	193	338	153	338	435	149	430	189	439
1901 ..	1158	225	797	183	442	210	355	158	361	457	189	536	172	394
1902 ..	1188	228	807	183	456	213	351	155	381	475	202	563	179	404
1903 ..	1216	231	837	188	457	211	380	166	379	466	201	551	178	397
1904 ..	1375	257	937	207	520	237	417	180	438	531	236	637	202	444
1905 ..	1261	233	833	182	471	212	362	154	428	511	229	609	199	432
1906 ..	1317	241	899	194	517	229	382	161	418	492	214	560	204	437
1907 ..	1317	238	879	188	484	212	395	165	438	509	227	585	211	446
1908 ..	1250	223	833	176	498	216	335	139	417	478	220	558	197	411
1909 ..	1273	225	815	171	460	197	355	146	458	518	258	645	200	413
1910 ..	1234	216	791	164	452	191	339	138	443	494	228	562	215	438
1911 ..	1165	201	733	150	437	183	296	119	432	475	235	570	197	397
1912 ..	1189	204	771	157	459	190	312	125	418	454	224	536	194	386
1913 ..	1138	193	743	150	411	168	332	132	395	424	211	498	184	362
1914 ..	1145	192	745	149	467	189	278	109	400	424	215	500	185	360
1915 ..	1098	183	673	133	416	167	257	100	425	445	237	544	188	362
1916 ..	1121	185	700	137	422	167	278	108	421	435	234	530	187	356
1917 ..	1213	198	730	142	453	178	277	107	483	494	281	628	202	380
1918 ..	1273	206	815	157	508	198	307	117	458	463	235	518	223	415
1919 ..	1029	143	670	109	388	126	282	91	359	344	195	407	164	291
1920 ..	936	128	616	99	335	109	281	89	320	294	141	265	179	323

TABLE 80.—*Number of deaths and rate of death, per 100,000 living inhabitants, from pulmonary tuberculosis, etc.*—Continued.

ALL FORMS TUBERCULOSIS.

Year.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1900 ..	1289	254	869	202	474	228	395	178	420	540	188	542	232	539
1901 ..	1393	271	945	217	519	246	426	190	448	567	236	669	212	485
1902 ..	1300	250	891	202	499	223	392	173	409	510	220	613	189	427
1903 ..	1378	261	940	211	514	237	426	186	438	539	232	636	206	459
1904 ..	1524	285	1044	231	572	260	472	204	480	582	258	697	222	488
1905 ..	1471	272	972	213	542	244	430	183	499	596	261	694	238	516
1906 ..	1492	273	1012	219	581	258	431	182	480	565	250	654	230	493
1907 ..	1495	270	987	211	544	238	443	185	508	590	269	693	239	505
1908 ..	1414	253	951	201	564	244	387	160	463	530	244	619	219	457
1909 ..	1440	254	932	195	524	224	408	167	508	574	281	702	227	468
1910 ..	1396	244	902	187	509	215	393	160	494	551	257	633	237	483
1911 ..	1388	240	874	179	518	217	356	143	514	566	280	680	234	471
1912 ..	1393	238	900	183	531	220	369	147	493	536	268	641	225	448
1913 ..	1341	227	868	175	472	193	396	157	473	507	250	490	223	439
1914 ..	1344	226	854	170	530	215	324	127	490	519	265	617	225	438
1915 ..	1291	215	798	158	482	193	316	123	493	516	283	650	210	404
1916 ..	1321	218	807	158	484	192	323	125	514	531	287	650	227	432
1917 ..	1407	230	858	167	522	205	336	129	549	561	317	709	232	437
1918 ..	1493	242	941	181	579	225	362	138	552	558	292	644	260	484
1919 ..	1245	173	802	130	456	148	346	112	443	425	243	508	200	355
1920 ..	1107	151	715	114	388	126	327	103	392	360	181	340	211	380

OTHER FORMS TUBERCULOSIS.

1900 ..	212	42	130	30	73	35	57	26	82	105	39	112	43	100
1901 ..	235	46	148	34	77	37	71	32	87	110	47	133	40	92
1902 ..	112	22	84	19	43	20	41	18	28	35	18	50	10	23
1903 ..	162	31	103	23	57	26	46	20	59	73	31	85	28	62
1904 ..	149	28	107	24	52	24	55	24	42	51	22	59	20	44
1905 ..	210	39	139	30	71	32	68	29	71	85	32	85	39	85
1906 ..	175	32	113	24	64	28	49	21	62	73	36	94	26	56
1907 ..	178	32	108	23	60	26	48	20	70	81	42	108	28	59
1908 ..	164	29	118	25	66	29	52	22	46	53	24	61	22	46
1909 ..	167	30	117	24	64	27	53	22	50	57	23	57	27	56
1910 ..	162	28	111	23	57	24	54	22	51	57	29	71	22	45
1911 ..	223	39	141	29	81	34	60	24	82	90	45	109	37	75
1912 ..	204	35	129	26	72	30	57	23	75	81	44	105	31	62
1913 ..	203	34	125	25	61	25	64	25	78	84	39	92	39	77
1914 ..	199	33	109	22	63	26	46	18	90	95	50	116	40	78
1915 ..	193	32	125	25	66	26	59	23	68	71	46	106	22	42
1916 ..	200	33	107	21	62	25	45	17	93	96	53	120	40	76
1917 ..	194	32	128	25	69	27	59	23	66	67	36	80	30	56
1918 ..	220	36	126	24	71	28	55	21	94	95	57	126	37	69
1919 ..	216	30	132	21	68	22	64	21	84	81	48	100	36	64
1920 ..	171	23	99	16	53	17	46	15	72	66	40	75	32	58

consequence for all forms of tuberculosis are uniformly much higher than for whites. For pulmonary tuberculosis during these 45 years, there is significantly close correspondence in the general course of the rates for whites, negroes, and total population. The rate of decline for whites is strikingly more acute than for negroes between 1875 and 1900. After the break in the descent of the courses of the rates for both races due to the sharp rise between 1900 and 1905, as shown by the rates as averaged for 5-year periods (table

TABLE 81.—*Average rate of death, per 100,000 living inhabitants, by 5-year periods, from all forms of tuberculosis, pulmonary tuberculosis, and other forms of tuberculosis, according to color and sex, from 1876 to 1920, inclusive.*

PULMONARY TUBERCULOSIS.

Periods.	Total.	White.			Colored.		
		Total.	Male.	Fem.	Total.	Male.	Fem.
1876 to 1880	355	299	296	303	663	658	668
1881 to 1885	340	279	275	283	667	716	629
1886 to 1890	286	239	248	230	552	574	534
1891 to 1895	243	199	211	189	485	548	435
1896 to 1900	215	174	198	153	440	504	388
1901 to 1905	235	189	216	163	488	579	414
1906 to 1910	228	179	209	150	498	582	429
1911 to 1915	195	148	179	117	444	530	373
1916 to 1920	172 193*	129 150*	156	102	406	470	353

OTHER FORMS TUBERCULOSIS.

1901 to 1905	33	26	28	25	71	83	61
1906 to 1910	30	24	27	21	64	78	52
1911 to 1915	35	25	28	23	84	106	67
1916 to 1920	31	21	24	19	81	100	65

ALL FORMS TUBERCULOSIS.

1901 to 1905	268	215	244	187	559	662	475
1906 to 1910	259	203	236	171	562	660	481
1911 to 1915	229	173	207	140	529	615	440
1916 to 1920	203 224*	150 172*	179	122	487	570	418

* Inclusive of 5-year average of deaths from pulmonary tuberculosis in sanatoria.

81), the curve for whites resumes its downward course immediately after 1905, and that for negroes not until 5 years later. The curves of the rates as averaged for 10-year periods from 1880 to 1920 show for the negro a sharp rise between 1900 and 1910, succeeded by a corresponding fall during the final 10-year period, while for whites the curve continues to descend between 1900 and 1910, but at an angle much less acute than before, and during the final 10-year period its angle of fall is again acute. The degree of decline in the rates based upon the official figures after 1910 is sharper for whites than for negroes, but this difference is apparent rather than real, for it disappears

when in the comparison the true rate for whites (table 85) is substituted for the official rate. The curve of the rate for the total population follows more closely that for the whites because of the predominantly greater numbers of the latter.

Coming now to other forms of tuberculosis, during the 20 years for which comparative figures exist the rates for whites have fallen and those for negroes risen, and the latter out of all proportion to the former.

The curves for whites and negroes for all forms of tuberculosis since 1900 show a much sharper fall for the former than for the latter race, but this difference in the angle of descent is much less marked when the curve for the true rates for whites is substituted for the curve of the misleading official rates.

The influence of sex upon deaths from tuberculosis can be determined for both whites and negroes for pulmonary tuberculosis since 1875 and for other and all forms since 1900 (tables 80 and 81, graph 24). While the annual rates for pulmonary tuberculosis for total population and for whites and for negroes have fallen in 45 years from 341, 298, and 580 to 128, 99, and 294, respectively, the rates for the sexes have fallen as follows: white males from 292 to 109; colored males from 627 to 265; white females from 303 to 89; and negro females from 546 to 233. Or, measured by the decline in rates averaged for 5-year periods the total rate has declined by 52 per cent (true rate by 46 per cent); the total whites by 57 per cent (true rate by 50 per cent); male white by 47 per cent; female white by 66 per cent; total negro by 39 per cent; male negro by 29 per cent; and female negro by 47 per cent. When the curves for the rates for pulmonary tuberculosis are plotted for race and sex, it is apparent that, while each follows in general the same course of the curves for the total population and for whites and negroes separately during this period, the peaks characterizing the period 1901–1910 are less marked and the descent occurring after the latter date is sharper in the females than in the males of both races. In the case of each race the averaged rates for females were at the beginning (1880) about the same as those for the males, and in the case of whites there was scarcely any difference before 1890. After 1890 for whites and after 1880 for negroes, the rates for the sexes deviate sharply, and by 1900 are widely separated. This in each instance is due to the more rapid and steady fall in the female rates. Toward the end, the angle of fall is somewhat more acute for white females and for negro males than for white males and negro females.

For other forms of tuberculosis since 1900, the rates for males and females of each race follow the same curve, but on the whole the course for whites is downward and that for negroes is upward. In consequence of the latter fact, and of the fact that the fall which occurred in the last 5-year period in the rates for negroes of both sexes is less abrupt than that for whites, the curves for all forms of tuberculosis fall less acutely for negroes of each sex than for whites of each sex.

In table 80 and in graph 24 the course of tuberculosis, pulmonary, other forms, and all forms, as previously described and illustrated for 5- and 10-year averaged rates, may be followed for each particular year. It will be noted that the upward and downward swings in the rates plotted by years do not correspond exactly with those of the somewhat arbitrarily averaged rates, but the correspondence is evidently sufficiently close to warrant the use made of

the latter method and to support, on the whole, the conclusions following from it.

A fact of considerable importance brought out by the graphic representation of the total rates by years for pulmonary tuberculosis, throughout the period, and for other forms and all forms since 1875, is that, while occasionally there are abrupt rises and falls involving individual years, on the whole the annual rates follow smooth courses over long swings either up or down. It will be noted that there were slight declines in the mortality rates for pulmonary tuberculosis after the influenza epidemics of 1814, 1849, and 1890, and a marked decline during the two years following the severe one of 1918. The lowest rate ever attained for the whole population previous to 1912 was in 1899, at the end of a long downward swing. After this date the rate gradually ascended, and but for the favorable influence exerted by the registration of sanatoria deaths out of the city and by the influenza epidemic of 1918, it is unlikely that the rate of 1899 would have been notably bettered, since the rates for both whites and negroes were apparently tending to stabilize after 1912 at the levels they had reached in 1899. It is of considerable interest that a drop in the rate for other forms between 1880 and 1898 coincides very closely with the fall that was occurring in that for pulmonary tuberculosis. The decline in the death-rates for all forms of tuberculosis for male and female of both races following the influenza epidemic of 1918 is striking. There were only slight differences between the rates from pulmonary tuberculosis for males and females of both the white and black races between 1875 and 1890–1895.

According to Frick's calculations, the mortality-rates for pulmonary tuberculosis in 1850 were 317 in whites and 468 in negroes. Of the total deaths of this disease in both races, 43.5 per cent were in males and 56.5 per cent were in females. There was no difference for the two sexes up to the fifteenth year of age, but from the fifteenth to the forty-fifth year he found the percentage of deaths was 38 for males and 62 for females. At that date the percentages of males and females in the population were 47 and 53, respectively. It is clear that in 1850 pulmonary tuberculosis was decidedly more fatal for females than for males; 25 years later the rates for the two sexes were approximately the same, and since 1890–1895 the rate in females (in both races) has gradually become much lower than in males. In the 67 years between 1850 and 1917 the rate for whites fell by over 50 per cent (from 317 to 142), and the rate for negroes actually increased from 468 to 494.

Data are available for studying the influence of age upon the mortality from pulmonary tuberculosis upon the whole population for the census years 1850, 1900, 1910, and 1920, upon whites and negroes of both sexes for 1910 and 1920, and for other forms of tuberculosis for 1910. Mortality-rates for pulmonary tuberculosis in the various age-groups of the whole population in these four census years are compared in table 82. Owing to differences of the age-groupings of the deaths in Frick's table for 1850, the rates for the divisions after the sixtieth year of age can not be compared with those for the other census years. As the figures for the total deaths as given in the general and special tables vary somewhat, and the population figures of the Bureau of the Census used in these calculations differ slightly from those used routinely elsewhere, the rates for all ages in the table are not identical in three

of the years from those of the general table (table 78) of mortality-rates for the disease. They are 344, 239, and 221, for 1850, 1900, and 1910, instead of 354, 212, and 216, respectively. In both tables deaths occurring in extra-urban sanatoria are excluded.

In 1850 the rate rose from 76 in the first decade of life to 145 in the second, 524 in the third, and 590 in the fourth. After receding to 510 in the fifth decade, the rate rose to 716 in the sixth, and after the sixtieth year fell to 583. In this year, therefore, the chances of dying of pulmonary tuberculosis were conspicuously greatest in the sixth decade of life. It is likely that this distribution of deaths among the age-groups did not change materially until after 1885. The course of the rates for the various age-groups was markedly different in 1900, after a period of 15 years in which the mortality-rates had been steadily declining. Though the rate for the first 5 years of life was

TABLE 82.—*Number of deaths and rate of death, per 100,000 living inhabitants, from pulmonary tuberculosis, according to age, for 1850, 1900, 1910, and 1920.*

D = death. R = rate.

Age-period.	1850		1900		1910		1920	
	D	R	D	R	D	R	D	R
Under 1 year	5	82	32	295	6	59	2	13
Between 1 and 2 years	17	92	25	83	7	22	16	29
2 to 4 years			11	117	3	31		
5 to 9 years	12	60	32	63	9	18	7	11
0 to 9 years	34	76	100	98	25	25	25	19
10 to 19 years	53	145	118	120	104	101	76	61
20 to 29 years	180	524	341	337	341	302	275	190
30 to 39 years	145	590	284	356	305	344	203	166
40 to 49 years	74	510	175	301	224	327	158	171
50 to 59 years	58	716	104	287	136	301	102	163
60 years and over	37	583	....	....	....	....	....	....
60 to 69 years	....	....	64	309	75	302	72	200
70 to 79 years	....	....	25	278	21	201	22	153
80 years and over	....	....	4	185	3	112	3	86
Total	581	344	1215	239	1234	221	936	128

notably higher than in 1850, there was little difference in the mortality between the fifth and tenth years of age. Starting at the advanced level of 98 in the first decade of life, the rate rose but slightly in the second to 120, sharply in the third, and attained 356, its highest point, in the fourth. From this level, except for a slight reaction in the seventh decade, the rate fell gradually through advancing years. In 1910, with a considerable decline in mortality in all the age divisions below the tenth year, the rate for the first decade was only 25. For the second, third, fourth, and seventh decades the rates were not significantly lower than in 1900. It was in early and in advanced life that the rates were lower than in 1900. In 1920, with rates for each age-group considerably lower than in previous years, the highest rates occurred in the third and seventh decades of life, the rates being considerably less in the fourth, fifth, and sixth decades. As in other years after the completion of the seventieth year, the chances of dying of pulmonary tuberculosis diminished sharply.

It will be noted that the decades of highest mortality were the sixth in 1850, the fourth in 1900 and 1910, and the seventh in 1920. However, since in 1920 the rate for the seventh decade was but slightly higher than in the third, it would appear that with the decline in the total rate one of the chief characteristics has been a relative decline in the rates before and after the third decade of life. For the white population, in 1910, the mortality-rate (table 83), comparatively low in the first 20 years of life, reached 213 in the third decade. The mortality varied but slightly during the next 3 decades, but between the sixtieth and the sixty-ninth years of life advanced to 287, its highest level. After the seventieth year it fell gradually, but in extreme old age the mortality-rate was still considerably higher than in childhood. In 1920, the mortality-rate (table 84) in the white population followed a somewhat different course in the various age-groups. Instead of rising, it fell in the fourth decade, and instead of running a level course during the fifth, sixth, and seventh decades, the rate gradually rose from the fortieth to the seventieth year of life. The decline during the remainder of life was much less and much more gradual than in 1910. These differences, so far as the age-period between the twentieth and fortieth years is concerned, were probably to some extent due to the larger proportion of deaths occurring in extra-urban sanatoria in 1920 as compared with 1910.

Among negroes, in 1910 (table 83), the rate was significantly higher than in whites in every age-group, but the differences were conspicuously greater at the extremes of life. The high level in the earlier years of life, attained in contrast to the rate for whites in the third instead of in the fourth decade, was maintained during the latter period. Between the fourth and the sixth decades there was a gradual decline in the rates. After falling considerably in the seventh, and remaining constant in the eighth decade, the rate approached the highest point in the age-period 80 and over. In 1920 (table 84), with the very considerable fall in the total rate for all ages, as compared with 1910, there occurred a notable change in the rates for the different age-periods, except the first and the seventh decades. As before, the highest level was reached in the third decade of life, but during the fourth, fifth, and sixth decades the rates descended steadily to a relatively very low level—from 441 to 191—and then rising sharply in the seventh decade, fell precipitously during the remainder of life. It will be noted that in 1920, when in both races the rates for all ages had undergone a marked recession as compared with 1910, the mortality-rates ran quite different courses after the fortieth year of age.

The general course of the mortality-rates for white males in 1910 and 1920 are in many respects similar. In both years the rates rose between the third and the seventh decades and fell during extreme old age. The main differences are that in 1910 the high level attained in the fourth decade is maintained during the next two decades and in the seventh decade there is a sharp rise in the rate, while in 1920 there is an unbroken ascent in the rates between the third and the seventh decades. A significant difference is the lowered rates in the second, third, and fourth decades of life in 1920 as compared with 1910. In comparison of the course of the rates for white females in these two years, there is to be noted that while high levels are reached in the third decade in both years, in 1910 there is but little change during the next three decades of life, while in 1920 the rates fall considerably during the latter

TABLE 83.—*Number of deaths and rate of death, per 100,000 living inhabitants, from pulmonary tuberculosis, other forms of tuberculosis, and all forms of tuberculosis, according to age, color, and sex, for 1910.*

ALL FORMS OF TUBERCULOSIS.

D = death. R = rate.

Age-period.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
Under 1 year.....	22	215	17	191	8	178	9	204	5	371	3	438	2	302
Betw. 1 and 2 years	14	146	10	118	6	137	4	98	4	355	1	180	3	526
2 to 4 years.....	21	65	11	39	6	43	5	36	10	241	1	50	9	420
5 to 9 years.....	21	42	9	21	5	23	4	19	12	187	4	131	8	238
0 to 9 years.....	78	77	47	53	25	56	22	50	31	238	9	143	22	327
10 to 19 years.....	136	132	72	81	26	61	46	100	64	465	29	496	35	442
20 to 29 years.....	368	326	217	235	109	245	108	225	151	732	71	785	80	691
30 to 39 years.....	327	368	211	289	123	346	88	235	116	734	69	902	47	576
40 to 49 years.....	237	346	160	280	98	356	62	209	77	676	47	831	30	523
50 to 59 years.....	144	319	107	274	67	355	40	198	37	610	23	777	14	451
60 to 69 years.....	80	323	68	310	50	506	18	150	12	416	7	530	5	379
70 to 79 years.....	23	220	19	201	10	254	9	163	4	402	1	248	3	506
80 years and over..	3	112	1	42	1	117	...	...	2	676	1	1075	1	493
Total	1396	250	902	191	509	222	393	161	494	581	257	653	237	518

PULMONARY TUBERCULOSIS.

Under 1 year.....	6	59	4	45	1	22	3	68	2	148	1	146	1	151
Betw. 1 and 2 years	3	31	3	35	3	68	...	...	...	...	...	....	...	...
2 to 4 years.....	7	22	2	7	1	7	1	7	5	120	...	....	5	233
5 to 9 years.....	9	18	1	2	1	5	...	...	8	125	3	98	5	149
0 to 9 years.....	25	25	10	11	6	13	4	9	15	115	4	63	11	163
10 to 19 years.....	104	101	54	61	18	42	36	78	50	363	20	342	30	379
20 to 29 years.....	341	302	197	213	99	223	98	204	144	698	65	719	79	682
30 to 39 years.....	305	344	197	270	118	332	79	211	108	683	64	837	44	539
40 to 49 years.....	224	327	152	266	92	334	60	202	72	632	44	778	28	488
50 to 59 years.....	136	301	100	256	62	328	38	188	36	594	22	743	14	451
60 to 69 years.....	75	302	63	287	48	486	15	125	12	416	7	530	5	379
70 to 79 years.....	21	201	17	180	8	203	9	163	4	402	1	248	3	506
80 years and over..	3	112	1	42	1	117	...	...	2	676	1	1075	1	493
Total	1234	221	791	167	452	198	339	139	443	521	228	579	215	470

OTHER FORMS OF TUBERCULOSIS.

Under 1 year.....	16	156	13	146	7	156	6	136	3	223	2	292	1	151
Betw. 1 and 2 years	11	114	7	83	3	68	4	98	4	355	1	180	3	526
2 to 4 years.....	14	44	9	32	5	36	4	29	5	120	1	50	4	187
5 to 9 years.....	12	24	8	19	4	18	4	19	4	62	1	33	3	89
0 to 9 years.....	53	52	37	42	19	43	18	41	16	123	5	79	11	163
10 to 19 years.....	32	31	18	20	8	19	10	22	14	102	9	154	5	63
20 to 29 years.....	27	24	20	22	10	22	10	21	7	34	6	66	1	9
30 to 39 years.....	22	25	14	19	5	14	9	24	8	51	5	65	3	37
40 to 49 years.....	13	19	8	14	6	22	2	7	5	44	3	53	2	35
50 to 59 years.....	8	18	7	18	5	26	2	10	1	16	1	34	...	...
60 to 69 years.....	5	20	5	23	2	20	3	25	...	...	...	....	...	...
70 to 79 years.....	2	19	2	21	2	51	...	...	...	...	...	....	...	..
80 years and over..	....	...	...	...	...	...	...	...	...	...	...	....	...	...
Total	162	29	111	23	57	25	54	22	51	60	29	74	22	48

TABLE 84.—*Number of deaths and rate of death, per 100,000 living inhabitants, from pulmonary tuberculosis, other forms of tuberculosis and all forms of tuberculosis, according to age, color, and sex, for 1920.*

ALL FORMS OF TUBERCULOSIS.

D = death. R = rate.

Age-periods.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
Under 1 year.....	24	162	11	85	5	76	6	95	13	661	9	940	4	396
1 to 4 years.....	46	84	27	56	13	54	14	58	19	297	6	193	13	395
5 to 9 years.....	17	26	7	12	4	14	3	11	10	124	5	130	5	119
0 to 9 years.....	87	65	45	38	22	37	23	40	42	255	20	252	22	258
10 to 19 years.....	95	77	45	42	9	17	36	66	50	313	18	255	32	360
20 to 29 years.....	306	211	176	148	76	129	100	166	130	503	50	410	80	586
30 to 39 years.....	222	181	141	140	80	159	61	122	81	371	42	380	39	362
40 to 49 years.....	174	188	122	159	76	199	46	119	52	334	35	422	17	233
50 to 59 years.....	115	184	95	174	67	251	28	100	20	225	8	188	12	332
60 to 69 years.....	80	222	65	200	44	287	21	122	15	433	7	409	8	457
70 to 79 years.....	25	173	23	176	12	214	11	147	2	147	1	165	1	133
80 years and over...	3	86	3	96	2	178	1	50	...	..	...	...	...	...
Total	1107	151	715	114	388	126	327	103	392	361	181	340	211	380

PULMONARY TUBERCULOSIS.

Under 1 year.....	2	13	...	...	...	...	...	...	2	102	2	209	...	...
1 to 4 years.....	16	29	4	8	2	8	2	8	12	187	4	128	8	243
5 to 9 years.....	7	11	4	7	3	11	1	4	3	37	1	26	2	48
0 to 9 years.....	25	19	8	7	5	8	3	5	17	103	7	88	10	117
10 to 19 years.....	76	61	36	33	6	11	30	55	40	251	15	212	25	281
20 to 29 years.....	275	190	161	135	68	116	93	154	114	441	44	361	70	513
30 to 39 years.....	203	166	130	129	73	145	57	114	73	335	34	308	39	362
40 to 49 years.....	158	171	111	145	68	178	43	112	47	302	31	374	16	219
50 to 59 years.....	102	163	87	159	61	229	26	93	15	191	5	118	10	277
60 to 69 years.....	72	200	59	181	40	261	19	110	13	375	5	292	8	457
70 to 79 years.....	22	153	21	161	12	214	9	121	1	74	...	...	1	133
80 years and over...	3	86	3	96	2	178	1	50	...	...	...	...	...	...
Total	936	128	616	99	335	109	281	89	320	295	141	265	179	323

OTHER FORMS OF TUBERCULOSIS.

Under 1 year.....	22	148	11	85	5	76	6	95	11	559	7	731	4	396
1 to 4 years.....	30	55	23	48	11	46	12	50	7	109	2	64	5	152
5 to 9 years.....	10	16	3	5	1	4	2	7	7	87	4	104	3	71
0 to 9 years.....	62	46	37	32	17	29	20	34	25	152	13	164	12	141
10 to 19 years.....	19	15	9	8	3	6	6	11	10	63	3	42	7	79
20 to 29 years.....	31	21	15	13	8	14	7	12	16	62	6	49	10	73
30 to 39 years.....	19	16	11	11	7	14	4	8	8	37	8	72	...	...
40 to 49 years.....	16	17	11	14	8	21	3	8	5	32	4	48	1	14
50 to 59 years.....	13	21	8	15	6	22	2	7	5	64	3	71	2	55
60 to 69 years.....	8	22	6	18	4	26	2	12	2	58	2	117	...	...
70 to 79 years.....	3	21	2	15	...	...	2	27	1	74	1	165	...	...
80 years and over...	....	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	171	23	99	16	53	17	46	15	72	66	40	75	32	58

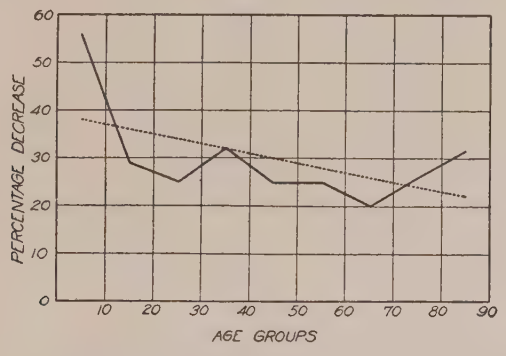
period. Though the rates were lower before the thirtieth and after the sixtieth years of life in 1920 than in 1910, the really significant differences lay between the thirtieth and sixtieth years. In negro males the rates in 1910 ascended by rather uniform grades through the first four decades of life, and after falling somewhat during the fifth and sixth, descended markedly during the seventh and eighth decades, to rise sharply in extreme old age to the highest level attained. In 1920, although the rates were considerably higher in the first 10 years of life than in 1910, thereafter they were much lower. Reaching a much lower level in the third decade, the rates fell somewhat in the fourth, rose in the fifth to a point slightly higher than in the third, and descended sharply in the sixth decade. After a considerable reaction in the seventh decade, which, however, fell far short of the previous high levels, the rate declined sharply in extreme old age.

In both 1910 and 1920 the highest rates for the negroes were reached in the third decade of life. In the former year there was a gradual recession of the rates during the fourth, fifth, sixth, and seventh decades, followed by a rise after the seventieth year. In the latter year there was a sharp decline in the rate during the fourth and fifth, with a corresponding rise during the sixth and seventh decades, and an abrupt fall after the seventieth year. It will be noted that in 1920 the rate for all ages was higher in female than in male negroes, and that this increase was due to higher rates in every decade of life except the fifth. The peculiar shape of the curve for the total rate at all ages for negroes in 1920 was determined largely by age distribution of deaths among the females. Speaking generally, it may be said that the evidence at hand indicates that in a period of decline in the total rates for all ages in the whole population, the fall in the rates has affected all age-groups and in much the same proportion. It further appears that the characteristics obtaining in 1910 for the rates in the different age-groups in whites and in negroes and in males and in females of both races were on the whole preserved in 1920. The inference seems justified, therefore, that the causes, whatever they may be, to which the decline in the rates have been due, have acted with a certain degree of uniformity.

Mortality rates for other forms of tuberculosis specific for color, sex, and age in 1910 are given in table 83. In whites the high rates of the early years fell sharply after the tenth year of life, while in negroes they persisted through the second decade. For the whole population and among whites the rates varied within narrow limits throughout life after the tenth year, but the rates for negroes were much less stable. The negroes' career with these forms of tuberculosis is apparently closed with the sixtieth year of age, while the white is pursued through old age. The rates for male and female whites followed much the same course through the earlier decades of life. The male rate showed a sharp fall in the fourth decade, followed by a rise lasting practically throughout the remainder of life. The female rate, on the other hand, rose during the fourth decade, fell sharply in the fifth, and ascended during the sixth and seventh. Among negroes the rate for males rose to its highest point in the second decade and fell in the third to a level which was not widely departed from until after the fiftieth year. In the female the rate, reaching in the first decade a level double that for males, conspicuously fell in the second and third decades and rebounded to a relatively high point in

the fourth and fifth decades. In general, then, the rates for the two sexes in the negro pursued opposite courses. The peak of mortality occurred in the male in the second and in the female in the first decade of life. The negro male, less severely affected than the female in the first decade, repaid this debt during the remainder of life. The female paid her tribute in early life and in middle age. In 1920, for the whole population (table 84), the rates were lower in each age-group below the sixtieth year than in 1910. For the whites, the rates were lower in each age-group except among females in the sixth and eighth decades. Among negroes, the rates were uniformly higher in all categories in the first year of life; for males for every age-group except 1 to 4 years and the second, third, and fifth decades; and for females in the age-groups under 1 year, 5 to 9, and in the second, third, and sixth decades.

When the decline in the mortality of all forms of tuberculosis from 1900 to 1920 is measured by the percentage of decrease by 10-year periods for each age-group, as illustrated by graph 25, it is evident that the greatest decline, over 55



GRAPH 25. Percentages of decrease, occurring between 1900 and 1920, in rates of mortality, specific for the decades of life, from all forms of tuberculosis in the whole population.

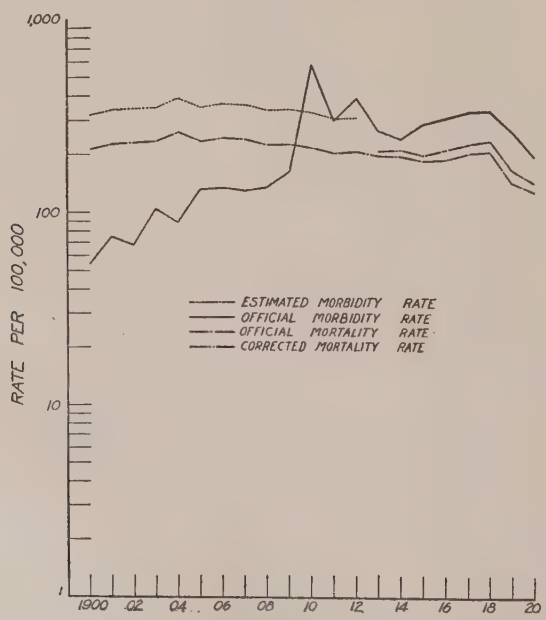
per cent, has occurred in the early ages. During the second and third decades of life, the percentages of decrease were approximately 29 and 25, respectively. An increase in the rate of decline (32 per cent) is noticeable during the fourth decade, after which time 25 per cent decrease obtained until during the seventh decade, when it dropped to 20. After the seventieth year, the rate of decline increased until in the later years of life the relative chance of dying from this disease was no greater than during early middle age. A straight line fitted to this curve indicates that the decrease in the death-rate was not only greatest in the earlier years of life, but gradually diminished with advancing years.

The records of the Bureau of Statistics give the reported cases of pulmonary tuberculosis in the whole population, without distinction for race, sex, and age, from 1900 to 1920, inclusive. The morbidity and mortality rates for this period are compared in table 85 and graph 26. From this table it is evident that the ordinance of 1894, requesting physicians to report cases, met with but little response, and that the effects of the state law of 1906 making pulmonary tuberculosis a reportable disease were slight before 1910. Before the latter date the bulk of the registered cases were not reported directly, but

TABLE 85.—*Number of cases, reported and estimated and respective rates, per 100,000 living inhabitants, and number of deaths and rate of death, per 100,000 living inhabitants, in the city and extra-urban sanatoria, from pulmonary tuberculosis, from 1900 to 1920, inclusive.*

C = cases. R = rate. D = death. R = rate.

Year.	Morbidity.			Mortality.					
				City.		Sanatoria.		Total.	
	C	R	Estimated rate.	D	R	D	R	D	R
1900	274	54	318	1077	212	....	....	....	....
1901	384	75	338	1158	225	....	....	....	....
1902	356	68	342	1188	228	....	....	....	....
1903	551	104	346	1216	231	....	....	....	....
1904	476	89	385	1375	257	....	....	....	....
1905	715	132	349	1261	233	....	....	....	....
1906	733	134	361	1317	241	....	....	....	....
1907	712	129	357	1317	238	....	....	....	....
1908	745	133	334	1250	223	....	....	....	....
1909	919	162	337	1273	225	....	....	....	....
1910	3292	575	324	1234	216	....	....	....	....
1911	1712	296	301	1165	201	....	....	....	....
1912	2248	385	306	1189	204	....	....	....	....
1913	1541	261	....	1138	193	72	14	1210	207
1914	1410	237	....	1145	192	83	17	1228	209
1915	1694	282	....	1098	183	66	13	1164	196
1916	1830	302	....	1121	185	111	22	1232	207
1917	2011	328	....	1213	198	125	24	1338	222
1918	2036	330	....	1273	206	138	27	1411	233
1919	1867	259	....	1029	143	131	21	1160	164
1920	1407	192	....	936	128	85	14	1021	142



GRAPH 26 (from table 85). Comparison of official and estimated crude mortality and morbidity rates from pulmonary tuberculosis in the whole population from 1900 to 1920, inclusive.

were recorded through the bacteriological laboratory as the result of sputum examinations. It was not until 1909 that the rate of recorded morbidity approached the mortality-rates and not until 1910 the the latter was exceeded by the former. The sudden great increase in the number of cases registered in 1910 was associated with the activity of the newly established division of tuberculosis, as the result of which a considerable number of cases previously known to physicians, dispensaries, and charitable agencies were at this time reported. Therefore, the morbidity-rate of this exceptional year was never again attained. Owing to careful scrutiny of the death certificates, since 1910 but few recognized cases of pulmonary tuberculosis have died without having been previously reported as clinical cases. In the 4-year period 1911–1914, there was a considerable drop in the morbidity-rate. During the four years 1915–1918 the rates rose continuously, but in 1919 and 1920 there was an abrupt fall.

The mortality-rates, though subject to annual fluctuations, did not, except for the rise culminating in 1904, vary very significantly between 1900 and 1912, and if the rates corrected for deaths in extra-urban sanitaria after 1912 be taken into account, they were at about the same level in 1914 as in 1900. After a slight recession in 1915, the mortality-rates, like the morbidity-rates, rose steadily until 1918, and dropped as abruptly in the next 2 years. In explanation of these facts, it is probably correct to assume that, on the whole, between 1910 and 1914, inclusive, most of the existing cases of active pulmonary tuberculosis belonging to the classes likely to be reported through one agency or another had been recorded. If this be true, it follows that the rise in the morbidity-rates between 1914 and 1918 and in the mortality-rates between 1915 and 1918, and the subsequent abrupt decline in both during 1919 and 1920, represent a distinct correlation between incidence and fatality of this disease since 1914. On an average in each year between 1914 and 1920, the morbidity exceeded the mortality-rate by about one-half.

In the light of these observations, several important inferences may be drawn. In the first place, had case reporting obtained before 1914 on the same plane as after this date, the course of the curves of morbidity and of mortality would probably have shown the same correspondence during the former as they did during the latter period, i. e., the fallaciously low rates before 1910 and the inordinately high rates between 1910 and 1912 would be replaced by morbidity-rates approximately one-half higher than the mortality-rates between 1900 and 1912. In this case the correct rates for the period before 1910 would not be far from those indicated by the estimated figures in table 85 and by the dotted line on the graph.

A second inference of importance is that within the limits of the experience of 1914–1920 the conditions determining the rises and falls in the rate of incidence effected simultaneously corresponding changes in the rate of death from pulmonary tuberculosis. In other words, the conditions which in a given time determine whether larger or smaller numbers of those exposed shall develop into clinical cases are also directly concerned in settling the rates in respect of time at which those so affected shall die of this disease. Whether the decline in both morbidity and mortality-rates in 1919 and 1920 was due solely to changes wrought by the influenza epidemic of 1918, or to these and to other causes as well, it is significant that both the incidence and

the fatality of this disease, essentially chronic in the large proportion of cases, at least, were affected in almost equal degree. While the low death-rate of 1920 may have been in large measure directly dependent upon the lowered morbidity of 1919 and 1920, after 3 years of increasing high incidence there were ample clinical cases in reserve for a death-rate in 1919 at least as high as that of 1918 had not conditions which determine rapid decline to a fatal issue ceased to act with their former force. As the margin between the number of cases of pulmonary tuberculosis arriving annually in the clinical state leading to reporting and the number of annual deaths is relatively small—not far from one-half—and as some of the cases reported recover, it follows that sudden rises in the death-rate must be first and largely at the expense of the reservoir of established cases.

The question of the degree with which the recorded morbidity since 1914 has reflected actual occurrence will be considered later.

For determining the distribution of reported cases of pulmonary tuberculosis by race and sex over a term of years, the only available data are the cases

TABLE 86.—*Number of reported cases and rate of morbidity, per 100,000 living inhabitants, of tuberculosis, according to color and sex, from 1916 to 1920, inclusive.*

C = cases. R = rate.

Year.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	C	R	C	R	C	R	C	R	C	R	C	R	C	R
1916 ..	1747	288	1413	277	617	245	796	308	334	345	168	380	166	316
1917 ..	1618	264	1261	245	731	287	530	204	357	365	176	393	181	341
1918 ..	1520	246	1191	230	725	282	466	178	329	332	177	391	152	283
1919 ..	1345	187	1003	163	543	177	460	149	342	328	156	326	186	330
1920 ..	1242	169	928	148	554	180	374	118	314	289	149	280	165	297

added to the visiting lists of the nurses of the tuberculosis division in the 5-year period 1916–1920. This material, which is presented in table 86, reflects but a rough approximation to actual occurrence. The figures for each year represent the number of cases out of the total number reported, either in the same or in some previous year, for which consent for nursing supervision was granted by the patient or by the attending physician. The discrepancy between these two categories is perhaps not only variable, but often considerable. Taking the material at its face value, however, it is notable that, on the whole, the proportional distribution of cases, as indicated by morbidity-rates, among whites and negroes and among males and females of the two races, is much the same as that found for deaths. Striking exceptions are, however, the higher rates for females than for males among whites in 1916 and among negroes in 1919 and 1920. The more accurate data concerning morbidity by color, sex, and age, which exist in 1921 (rates calculated on the figures of the Bureau of the Census of the population in 1920) are given in table 87. The proportional distribution of reported cases in this year according to these three categories corresponds in some degree with that found to obtain for

deaths in 1920. For the whole population, as well as for whites and for negroes, there is the same sharp ascent of the rates from early youth to a peak reached in the third decade of life.

From this period onwards the morbidity-rates decline much more sharply than do the mortality-rates. The shape of the curves is very similar for the morbidity-rates for the three categories. As between males and females, among whites, the rates for the latter are higher under the twentieth year, lower between the twentieth and thirtieth years, and after the latter age show a sharp decline which continues, but for a slight reaction in the seventh decade, throughout the remainder of life. In males, on the contrary, the high level attained in the third decade is maintained during the fourth and fifth decades. After a sharp decline in the sixth decade, the rate remains very much on the

TABLE 87.—*Morbidity, per 100,000 living inhabitants, from pulmonary tuberculosis, according to age, color, and sex, for 1921.*

C = cases. R = rate.

	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	C	R	C	R	C	R	C	R	C	R	C	R	C	R
Under 1 year.....	9	61	5	39	4	61	1	16	4	203	2	209	2	198
1 to 4 years.....	40	73	20	42	9	37	11	46	20	312	10	321	10	304
5 to 9 years.....	50	78	38	67	17	59	21	75	12	149	5	130	7	166
Under 10 years....	99	74	63	54	30	51	33	57	36	219	17	214	19	223
10 to 19 years.....	173	140	101	94	44	83	57	104	72	451	21	297	51	574
20 to 29 years.....	460	317	330	277	185	315	145	241	130	503	71	583	59	432
30 to 39 years.....	299	244	231	230	143	284	88	176	68	312	41	371	27	251
40 to 49 years.....	220	238	161	210	117	306	44	114	59	379	41	495	18	247
50 to 59 years.....	85	136	69	126	43	161	26	93	16	204	11	259	5	138
60 to 69 years.....	44	122	41	126	22	144	19	110	3	87	2	331	1	57
70 to 79 years.....	10	69	9	69	8	143	1	13	1	74	1	746	...	...
80 years and over..	....	...	....	...	...	...	...	...	...	...	...	...	...	...
Total	1390	189	1005	161	592	192	413	130	385	354	205	385	180	325

same level to the end of life. The course of the morbidity- and mortality-rates in these two groups is alike in that in both the rates for the female are higher than those for the male in early life, and that the rates for female decline after the third decade. In the white male the course of both rates is very similar between the thirtieth and the fiftieth years. In the negro there is for both sexes a striking correspondence in the shape of the curves for morbidity and mortality for the different age-groups. In summary, it is to be observed in the two races that for morbidity as for mortality the courses of the curves in general are strikingly similar for females and somewhat similar for males. These correspondences would probably be even closer if comparison could be made for the same year and if the mortality data included the deaths occurring in the extra-urban sanatoria.

The numerous factors which may have affected directly or indirectly the incidence and mortality of tuberculosis in the 109 years under review will be discussed as briefly as possible under population, eleemosynary agencies, gen-

eral sanitation, specific measures of administrative control, and the influence of other diseases.

Influence of population changes upon mortality from tuberculosis may be conceived to have been exerted through rate of growth, changes in racial composition, financial prosperity and depression, and the quantity and quality of food. Taking pulmonary tuberculosis as the criterion for comparison, and the data recorded in Chapter VIII for details in regard to population growth and composition, it would appear that mere growth in numbers, determined very largely during most of the nineteenth century by rate of immigration, was not an important factor in the decline in the death-rate. The very high death-rates obtaining in 1812 occurred in a city of about 50,000 inhabitants after a prolonged period of an exceptionally high rate of increase, about 9 per cent per annum, over a period of something more than 30 years, in the population, and the marked decline in the rate between 1812 and 1840 took place during a period of marked and steady decline in the rate of population increase (table 9). On the contrary, the great rise in the death-rate from pulmonary tuberculosis after 1840 and the culmination in 1855 followed a great and sudden rise in the rate of population growth due to immigration, between 1840 and 1850, and perhaps for several years of the sixth decennium.

Coincidentally with the decided fall in the rate between 1855 and 1865, and the practically stabilized death-rate obtaining between 1865 and 1880, the rate of population increase had returned to a much lower level, maintained for three decades (1850 to 1880) at about 25 per cent or 2.5 per cent per annum, approximately the same rate of increase which characterized the decade between 1830 and 1840. The marked and steady decline in the tuberculosis mortality which took place between 1880 and 1900 happened in the face of an accelerated growth-period (30.7 per cent) in the first decade and in the face of a retarded growth-rate (17.2 per cent) during the second decade. On the other hand, the distinct check in the rate of decline of the death-rate, amounting to almost a standstill, that occurred between 1900 and 1910, was associated with the very lowest rate of population increase (9.7 per cent) recorded. Similarly with the rise in the rate of population growth to 13.8 per cent during the last decade, 1910–1920, the pulmonary tuberculosis death-rate declined on the whole. It is clear that excessive rates of population growth were definitely associated with high death-rates, that moderate rates of population increase were accompanied by falling or stationary death-rates, and that a very low rate of population increase was coincident with a slight rise and then a slight fall in the death-rate, and, lastly, that a slight increase of population growth was followed by a resumption in death-rate decline. As any increase in the rate of population growth of over 1 per cent or 1.4 per cent per annum in the Baltimore population is greater than the natural increase by excess of births over deaths, and must, therefore, be due to immigration, it is evident that there has existed a very definite relation between high death-rates from pulmonary tuberculosis and the immigration rate, i. e., the former have risen and fallen with the tide of the latter. Therefore, it is here of prime importance to examine with some care such pertinent characteristics of these immigrants as race stock, place of origin, previous living and social conditions, and chances of financial and social success on and after arrival. As these matters have been dealt with in detail in the chapter

on population, it is only necessary here to bring together in condensed statement the essential facts there recorded.

The high pulmonary tuberculosis death-rates of 1812 and the years immediately succeeding affected a population of 78 per cent white and 22 per cent negro. The whites were predominantly of British extraction and of colonial descent, but with a considerable proportion of individuals of only the first and second generation in this country. It is certain that the bulk of this element could not have been city dwellers in either America or in Britain for more than one generation, since but few American cities from which they would have come had long been populous, and the trend here, as in Britain, at that time was from rural to urban, and persons of this type well established in one growing city would not in large numbers migrate to another. This element formed the majority of the educated and wealthy citizenhood. The considerable body of persons of French extraction were in the second generation and had become relatively prosperous, and the same conditions applied to most of those of German extraction. Thus, whites of the relatively very rich and thriving city, composed largely of stocks hardy and robust, drawn from the country, could not in any large proportion have been inured to city life. The white population which had for three decades been increasing at the rate of about 90 per cent, during the next three decades (1810–1840) increased at a much less rapid rate—about 30 per cent per decade.

In 1810 the negro population was practically new to town and city life, the 10,343 then present had increased by 256 per cent between 1790 and 1800, and grew by 84 per cent during the following decade. In the next three decades during which the death-rate from pulmonary tuberculosis fell so sharply (graph 21), the negro population increased at a very much less rapid rate (42, 29, and 12 per cent, respectively), and between 1830 and 1840 but relatively slightly from immigration, but in 1840, out of a population of 102,000, they formed 20 per cent. As during all this period their general death-rate had been much higher than the white, it is probable that their death-rate from pulmonary tuberculosis was, as it is known to have been in 1850, correspondingly higher. The greater part of the negroes were free, and, though many of them were probably relatively well to do, in comparison with the whites they were poor and illy housed and inadequately fed. Therefore, during this period of decline of the death-rate from pulmonary tuberculosis, roughly between 1820 and 1840, the most susceptible elements in the population, the negroes and the other recent rural immigrants, were gradually decreasing numerically in importance, and the older, more stable white population was in the same manner running into more generations and becoming more inured to urban life and perhaps to tuberculosis. The negro was undergoing the same process, but with in each case a relatively greater distance to cover.

The fifth decade of the nineteenth century marked a radical change in both the population composition and in the tuberculosis death-rate. While the latter rose sharply and steadily after 1840 and reached a new high peak 15 years later, the population, which had, since 1830 at least, been receiving, besides migrants of British extraction, considerable additions of Irish and Germans—probably both in larger proportions from rural districts—during and immediately following the fifth decade was augmented by the influx of crowds of the latter two races, largely refugees from starvation or political

oppression or both. In this decade the white population increased by 73 per cent and the negroes expanded by 34 per cent, and by 1850 practically all the negroes were free and had to shift for themselves. Thus there was in a comparatively short time a great growth in population, the new elements of which were largely if not entirely destitute.

The overcrowding, the poverty, and the illness from various diseases, particularly small-pox, typhus fever, measles, and intestinal diseases, was excessive. After 1850, for the next 40 years the white population increased at an average rate of 2.7 per cent a year—31 per cent in the first and last and 23 and 22 per cent during the intermediate decades. Between 1850 and 1860 the negro population showed both an actual and a large relative decrease. It rebounded during the next decade with a 41 per cent increase, but its rate of increase then sank gradually to 25 per cent for the decade 1881–1890. Since 1890 the negro, as well as the white population, has increased at slower rates. The migration of Austrians, Bohemians, Poles, and Italians, among the whites, since 1870, has brought in not only new races apparently more resistant to tuberculosis than the Irish and Germans, but, by supplying great additions to the group of manual laborers, has probably seriously restrained immigration of negroes. These people, however, have come very largely from villages and rural districts and have perhaps retarded rather than accelerated any tendency to the fall of the tuberculosis death-rate among whites. They arrived, however, in a period of prolonged and relatively high prosperity, during which living conditions and wages have improved. On the other hand, the German and Polish Jew populations, the former growing long and slowly and the latter rapidly and only since 1884, representing a race or at least races—for the strictly semitic racial origin of the Polish Jew is questionable—long inured to urban life and intimate associations with the disease, have probably exerted an influence even more favorable upon the death-rate, particularly during the last 30 years.

It is difficult to determine the influence of prosperity and depression in business upon the history of tuberculosis in such a composite and unwelded population. The very high death-rates obtaining in the early years and lasting until 1820 occurred in the period of trade depression which preceded and followed the war of 1812–1815. The considerable reaction in the rates which took place between 1830 and 1835, after 10 years of sharp decline, synchronized in time to some degree with the financial depression connected with the fight over the national bank act. The rate which had fallen during the 10 years previous to 1865 remained almost stationary during the local financial depression following the Civil War period. During the period of the return of relative prosperity which set in after 1880, there began the great decline which lasted 20 years. However, in the almost equal stretch of years 1900 to 1918, with unexampled prosperity, there was practically no gain over the forces of mortality.

Baltimore markets have, except during some years of the Civil War, never lacked food in abundance and variety for those who could buy, so the question of food-supply for the general population has been a relative one of wages and of intelligence in selection and preparation of diet. The people, on the whole, have throughout the period under consideration fared well in comparison with other communities, food having been relatively cheap and well

prepared. It is probable that much less milk and milk products have been utilized than would have been of advantage, but not less and perhaps more, than in other cities. The records of the health department indicate that per capita consumption of milk has greatly increased during the last 30 years.

It has been pointed in other chapters that Baltimore has never lacked charitable agencies, such as benevolent associations, homes for the aged and orphans, and dispensaries and hospitals, by means of which the needy have been cared for and the indigent sick treated. Until recent years cases of tuberculosis formed a conspicuous portion of the clientele of general dispensaries and hospitals. They always received without stint, certainly in the dispensaries, the current orthodox medicines and general advice. General civic interest in tuberculosis was aroused first, perhaps, by Dr. Osler. A special commission authorized by the legislature in 1902, under the chairmanship of Dr. W. S. Thayer, rendered an exhaustive report. As a direct outcome of this, a tuberculosis exhibition was held in January 1903. Under the leadership of Drs. Welch, Osler, Thayer, Jacobs, Jones, Fulton, and numerous prominent laymen, the Maryland Society for the Prevention of Tuberculosis was organized in 1904. It has been the center of anti-tuberculosis propaganda and has been largely instrumental in securing all subsequent legislation on the subject. The association has been a strong influence in securing the State Tuberculosis Hospital (1908), the Municipal Hospital for advanced cases (1904), Eudowood Sanatorium (1904), the Jewish Hospital for Consumptives, and the Division of Tuberculosis of the city health department. Through the influence of Dr. Osler, the Phipps Tuberculosis Dispensary was established in connection with the Johns Hopkins Hospital in 1904.

It is unnecessary to review here the history of the attempts at nuisance control as applied to paving, street cleaning, sewage disposal, water, food, and the like, which have been treated fully in previous chapters. Suffice it to recall that the efforts in these directions in most respects were hopelessly inadequate and could not have exerted any favorable influence until very recent years. Striking declines in the tuberculosis death-rate took place under general sanitary conditions of the worst kind. It is possible that a gradual abandonment brought about after 1880 of the use of water of wells and springs grossly polluted with human excreta from cesspools and privies, and therefore potential carriers of tubercle bacilli, may have exerted a favorable influence upon tuberculosis death-rates. The general water-supply could not have been heavily laden with human, but was perhaps well seeded with bovine tubercle bacilli. Too little is known of the fate of *B. tuberculosis* in polluted drinking-waters to warrant stressing this point, particularly in a community in which infection would so readily occur by other means.

The development of small parks, never numerous except about the city springs, in the closely built areas, hardly began before 1870, and the large parks were not available at all to the great mass of the people until the development of cable and electric traction in the last decade of the nineteenth century. The same innovation was primarily responsible for the departure from the old custom of substituting wide streets and separate houses in new developments, such as the northern margins of the city, for the old, closely built blocks. However, the great mass of the people continued to dwell in the latter. The housing and building laws of recent years were not retroactive, and were

passed *after,* in certain parts of the city, whole blocks had become almost solidly built up with dwellings, and family on family had been stacked in what had been previously single-family dwellings. While, in the last 20 years, many dwellings in alleys and courts have been condemned or improved, it is not possible to determine with any accuracy whether, on the whole, the housing conditions of the great bulk of the population living in closely built areas was any worse or any better in regard to crowding and lack of reasonable sunlight and air, at any particular date between 1812 and 1900 during which time the death-rates fell and rose again. Naturally, marked overcrowding must have always succeeded excessively active immigration and have lasted for some years until building operations caught up with the demand. But in periods of fairly steady migration, construction and demand have closely coordinated.

In this sense, excess in growth by immigration as before 1812 and in 1840–1850 may have influenced the high rates obtaining by increasing the rates among both migrants and indigenes. However, government regulations and laws can not be shown to have exercised any material influence. The inspection conducted by the tenement and lodging house division of the health department since 1912 has undoubtedly improved the general cleanliness of dwellings of this type.

The improvements in the milk-supply developed very gradually between 1894 and 1918, but except for the exclusion of milch cattle from the city, they can not, until effective pasteurization was enforced in the latter year, be held to have exerted any marked influence upon massive dosage of *B. tuberculosis* on any considerable proportion of the population. The establishment of the Walker-Gordon Milk Laboratory and the sterilization in private homes of milk for babies and young children doubtless may have exerted a favorable influence in this respect. On the whole, the amount of bovine bacilli taken by the population must have been considerably, though very gradually, cut down since 1900, due to the efforts of farmers, dealers, and the health department.

Butter has probably, through the same influence, become a less potent vehicle for the transmission of bovine tubercle bacilli. Federal meat inspection may also have to some degree accomplished the same results in regard to meats, but no such claim can be made for that instituted by the health department.

The great advances in the diagnosis and treatment of tuberculosis of bones and joints and of the cervical lymph-glands during the same period can hardly have been without influence distinctly favorable, particularly upon the death-rate for other forms of tuberculosis.

The growth of public and private measures of prophylaxis can hardly have failed to exert a considerable influence by rendering less common than formerly opportunities for repeated massive infection with tubercle bacilli of the human type determining attacks of tuberculosis running an acute course.

Administrative activities on the part of the health department, directed specifically to the control of the spread of tuberculosis through measures affecting persons and their immediate surroundings, began in 1896 and have developed leisurely and according to accepted canons but imperfectly. The first measure, tentative and feeble, was the passage of an ordinance directing the commissioner of health to keep a registry of cases of pulmonary tuberculosis

and requesting physicians to report cases. The commissioner was, however, forbidden to assume sanitary control of tuberculous persons, except on the request of attending physicians, unless they were residents of tenements, boarding-houses, or hotels. Sputum examinations, free of charge, were undertaken by the newly established bacteriological laboratory the same year. But few cases were registered except through the laboratory, and there was no machinery provided for the supervision of the class of cases covered by the ordinance.

Between 1900 and 1905, Dr. C. Hampson Jones made a number of statistical and topographical studies on pulmonary tuberculosis in Baltimore, collaborated actively with the tuberculosis commission authorized by the legislature in 1902, and contributed largely to the success of a tuberculosis exhibition. It was by a legislative enactment in 1904 that the reporting of cases of pulmonary tuberculosis by physicians and heads of institutions was made compulsory, and the health department was required to fumigate the living quarters of known cases of pulmonary tuberculosis after removal on account of death or other reasons, and to furnish consumptives with sputum-cups, disinfectants, and printed instructions in regard to prophylaxis. Physicians who cooperated with the health department in the supervision of their consumptive patients were to receive a small fee from the state. The law further provided that on the refusal or neglect of the attending physician to cooperate, the function of oversight of a consumptive devolved upon the health department. Except to inaugurate in 1906 fumigation with formaldehyde gas of the living apartments of consumptives after death, the Baltimore health department did nothing to carry out the provisions of this law until 1910. The ordinance of 1905, forbidding expectoration in streets and other public places, with the strong support of public opinion, was so effectively enforced by the police that by 1910 the spitting nuisance was effectively controlled.

Under the general supervision of Assistant Commissioner Jones, a division of tuberculosis was established in the health department on January 1, 1910. The simple organization consisted of 14 trained nurses, under the direction of a superintendent of nurses, of experience, intelligence, and force. For administrative purposes the city was divided into 14 districts, to each of which a nurse was assigned. The new division took over at once 1,617 cases of pulmonary tuberculosis from the Visiting Nurses' Association, an ably managed organization which had for 6 years, in addition to its other work, cared for needy tuberculous patients. In many respects this innovation signified only that the health department superseded a private organization in the nursing care of a large number of cases of pulmonary tuberculosis. In the very important respect, however, that the public-health nurses were in larger force and acted under the authority of the health department, conditions were materially changed. In regard to giving advice and instructions to ambulatory cases, nursing care to bedridden cases, and assistance in gaining admission to sanatoria and to the Municipal Hospital, there were no important changes. The chief innovations immediately introduced were the supervision of many more cases, the supplying of sputum-cups, paper napkins, and disinfectants, the giving of more specific advice in regard to mode of life and changes in home surroundings and in vocation, the arranging to have all members of families of tuberculosis patients submit to expert medical examination, the

selecting of the most suitable cases for sanatoria and the Municipal Hospital for advanced cases, and finally, the arranging for the fumigation of rooms, sterilization of infected clothing and bedding, and the insisting upon the cleaning and airing of the dwellings of "open" cases of pulmonary tuberculosis. In 1912, 2 more nurses were added to the division and in 1917 the number of nurses was increased to 20. Two dispensaries were opened in 1912 and an additional one in 1916. The principles of action of Miss LaMotte, the first superintendent of nurses, as set forth in her first two annual reports, were simple and direct. As the primary work of the health department was to minimize infection, it was most important to control advanced cases. To those for whom hospitalization could not be had, frequent visits of instruction and oversight must be made. Though a close working relation was maintained with charitable organizations, to which the needy were often referred for relief, special diet was never to be requested for the tuberculous unable to buy it, because of the premium that would be set upon their remaining at home. All comfort and relief afforded to individuals was regarded as only incidental.

"Our function is to try to reduce the amount of tuberculosis in the community, and this is best done by concentrating our efforts on care of the last-stage case. . . . . The object of the division is to bring under supervision every case of pulmonary tuberculosis in the city. Many require little beyond advice, supplies, and general instructions. Bedridden cases require nursing care, and it is upon these and their contacts that chief effort is concentrated."

In connection with a request for special tuberculosis dispensaries in 1911, she wrote

"The chief, almost the only value of the dispensary lies in its being a diagnosis agency; treatment amounts to practically nothing."

The physician in charge of the department's tuberculosis dispensaries has acted on this principle. Cases found positive are advised to go to sanatoria, and if this can not be accomplished, the association with the dispensary usually ceases. Neither the methods of procedure nor the ideas underlying them have undergone material changes in 10 years.

A general idea of the activities of the division of tuberculosis and of the sources of the cases reached and of their disposal during the 11-year period 1910–1920, may be obtained from table 88, which was compiled from the annual reports of the superintendent of nurses. Owing to changes in the forms of these reports specific information under some of the headings is lacking in the later years. The figures in column 1 represent the total number of persons recorded in the visiting-list in each calendar year as either positive or suspicious cases of pulmonary tuberculosis. They do not include, however, the large number of persons who, on account of household association with positive or suspicious cases, were taken by the nurses to dispensaries for medical examination. These are included in the group "Referred to dispensaries." Owing to the uncertain duration of their stay, patients in sanatoria have been kept on the visiting-lists until death or recovery. In but few years are there references to cases discharged for the latter reason. It will be noted that the number of individuals annually on the lists increased very gradually between 1910 and 1916, and, then, after remaining nearly constant for 3 years fell considerably in 1920.

Death was invariably the chief cause for loss of names from the list, but the annual losses due to removals from the city and to changes of address were considerable. Of less and continuously decreasing importance were losses due to the discharge of suspicious cases as non-tuberculous. This change was largely the result of the growth in discrimination in the light of experience. The number of cases on the list at the end of each calendar year (column 6) represents the difference between the whole number listed (column 1) and the net losses (column 2). The figures in column 6 indicate in a rough way the approximate number of individuals on the visting-lists at any time in the several years known or thought to have pulmonary tuberculosis. This number grew very steadily from 2,416 in 1910 to 4,702 in 1916. Since the latter date the number of persons constantly under supervision was not far from 5,000. During the period in which they were separately recorded, the proportion of suspicious to positive cases steadily declined. In columns 9 and 10 are given the numbers of new and old cases listed in each year. The number of new cases added to the lists in no year corresponds with the number of cases officially reported (compare with table 85). These discrepancies are due to the acts of private physicians in withholding permission to visit entirely or for a longer or shorter time after reporting cases. Similarly, under sources of reported cases, the figures in column 11 indicate only the numbers of cases reported by physicians for which permission to visit was granted in any particular year.

It will be noted that since 1916, as the division of tuberculosis has gained the confidence of the physicians, an increasingly large proportion of the reported cases appear on the visiting lists. However, in later years it is evident that less than half of the reported cases of pulmonary tuberculosis could have been under the care of private physicians. The relatively important part played by the Phipps Dispensary, which since 1904 has superseded, in regard to pulmonary tuberculosis, the medical clinic of the Johns Hopkins Hospital, reflects in part the reputation of the hospital. The tuberculosis clinic of the University of Maryland as a branch of the medical clinic of the University Hospital, and the three dispensaries of the health department have contributed comparatively lightly to the whole number of reported and listed cases. Under the heading "other sources" are included the numerous general dispensaries and various charitable organizations. Under hospitalization the table shows all the known data in regard to hospital care, both for isolation and for cure, given at public expense. Here, however, no account is taken of cases received in general hospitals for longer or shorter periods, nor for the many cases, particularly among the well-to-do, that have gone to distant resorts. To the Municipal Hospital have been sent only advanced and hopeless cases selected from among many claimants by the nurses as particularly dangerous to their families. Relatively few who enter this institution leave alive. It will be noted that the number of annual admissions—about 300 between 1910 and 1917—greatly decreased in the last 3 years. At Eudowood Sanitorium, where 30 of the 70 beds are reserved for advanced cases, the admission-rate has fallen off since 1916. The high level of admission to the Jewish Hospital was reached in 1914 and 1915; since the latter year the admission-rate has greatly declined.

The annual admissions to the State Sanatorium, reserved for incipient and moderately advanced cases, increased in number almost uninterruptedly from 107 in 1908 to 479 in 1917, but since the latter date there has been even here a slight falling off. The highest point in hospitalization was reached in 1915, with 321 admissions to the Municipal Hospital and 656 to the three sanatoria. By 1920 these figures had fallen to 130 and 566, respectively. Under admissions to other sanatoria are included the relatively few cases reported by nurses as having gone to distant resorts. These belong to the class for whom permission to visit is rarely granted. Among the patients sent to the three extra-urban sanatoria between 1913 and 1920, the years for which records of deaths among them have been kept, the fatality-rate varied from 10 to 23.5 per cent. In other words, of the picked cases sent to curative sanatoria, on an average over 17 per cent died while in these institutions. The proportion of deaths occurring among those who returned to the city is unknown. The activity of the nursing force in the various years, as measured by the number of visits paid, fumigations of dwellings supervised, persons sent to dispensaries, and new cases apprehended, is indicated in columns 25, 26, 27, and 28 of table 88. It will be observed that the greatest number of visits paid in any one year was 87,102 in 1917, when a total of 6,645 persons were under observation. The number of fumigations supervised varied with the numbers of deaths and the movings of recorded living cases.

The reports contain some data throwing light upon various phases of the tuberculosis problem in Baltimore and on the value of the efforts exerted for its solution. According to Miss LaMotte's analysis of the 3,107 positive and suspicious cases of pulmonary tuberculosis on the visiting-lists on December 31, 1912, 20 per cent were recipients of charitable aid. She estimated that a possible additional 20 per cent were on the verge of need of such assistance. At least 50 per cent of the cases were well beyond want. Many of these "live in excellent houses and are far removed from the dire poverty, overcrowding, and unsanitary quarters usually considered to play such a great part in the spread of tuberculosis." In 608, or 19 per cent of the houses, the patients conducted some sort of small industry, the chief types being laundries, 222; boarding-houses, 104; sewing, 104; lodgings, 18; shoemaking, 21.

An analysis of the positive cases on the visiting-lists on December 31, 1915, in regard to stage of the disease, ability to work, and response to instruction is probably typical of other years. In respect of stage of the disease, of the 3,606 cases, there were classed as incipient 107 (2.9 per cent), moderately advanced 1,981 (54.9 per cent), advanced 752 (20.9 per cent), chronic 405 (11.2 per cent), arrested 361 (9.1 per cent). Of the whole number under observation, 569 were hospitalized and 3,037, or more than 80 per cent, were in their homes. According to physical capacity, there were able to work full time, 1,838; part-time, 715; unable to work but not confined to bed, 391. Only 93 were bedridden. In regard to amenability to instruction for the protection of associates, the 3,245 active cases were classified as adequately careful, 548; moderately careful, 1,322; careless, 1,375, or in the proportion of 17, 41, and 42 per cent respectively.

In any scheme for the prevention of tuberculosis by control of cases of the disease it is of capital importance that cases be recognized and reported in their early stages. The degree in which this essential condition has been met

TABLE 88.—*Administrative activities directed toward the control of tuberculosis, from 1910 to 1920, inclusive.*

Year.	Recorded cases.										Cases reported by—					
	Total number of persons on list.	Losses.				Cases listed at end of year.			New cases.	Old cases returned.	Physicians.	Phipps Dispensary.	University of Maryland dispensary.	Health department dispensaries.	Tuberculosis nurses.	Other sources.
		Total.	By death.	By removal, etc.	Non-tuberculous.	Total.	Positive.	Suspicious.								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1910	4251	1835	776	620	439	2416	1967	449	2591	43	432	431	107	...	706	915
1911	4319	1547	814	484	249	2772	2225	547	1816	87	349	391	83	...	358	625
1912	4743	1636	856	611	169	3107	2522	585	1892	79	382	418	58	27	251	756
1913	4985	1585	867	566	152	3400	2728	672	1777	101	328	406	70	62	214	697
1914	5192	1535	838	495	202	3729	3181	548	1704	88	286	439	39	133	157	650
1915	5600	1359	853	447	59	4175	3606	569	1759	112	421	404	61	97	113	663
1916	6135	1425	980	403	41	4702	?	?	1859	101	606	?	?	132	?	?
1917	6645	1764	1086	644	34	4881	4275	606	1869	74	682	?	?	134	?	?
1918	6665	1672	1176	482	14	4493	?	?	1767	17	765	214	20	64	64	340
1919	6613	1755	936	791	28	4858	?	?	1575	45	670	243	25	62	?	575
1920	6317	1596	872	703	21	4721	?	?	1418	41	633	151	22	96	20	496

Year.	Hospitalization.								Nursing activities.			
	Municipal hospital.	State sanatorium.	Eudowood sanatorium.	Jewish Sanatorium.	Other sanatoria.	Patients admitted to state sanatorium, Eudowood, and Jewish Sanatorium.	Number of deaths.	Percentage, case fatality.	Referred to dispensaries.	Total number of visits by nurses.	Houses fumigated after death of patients.	Houses fumigated after removal of patients.
	17	18	19	20	21	22	23	24	25	26	27	28
1910	339	107	79	25	....	211	....	....	2903	.....	1162	1742
1911	291	109	109	33	....	251	....	....	1917	61195	1186	2011
1912	310	180	123	53	....	356	....	....	3082	72058	1157	1769
1913	298	295	116	61	....	472	72	15.3	3375	79743	1107	2186
1914	286	365	105	94	1	564	83	14.7	2785	82726	1110	2264
1915	321	464	98	94	14	656	66	10.1	2618	75773	1042	2388
1916	286	443	105	60	13	608	111	18.3	2141	83907	1288	2256
1917	308	479	83	68	14	630	125	19.8	3012	87102	1100	1903
1918	175	438	96	53	9	587	138	23.5	1637	82528	4457	
1919	160	475	78	63	5	616	131	21.4	1796	76505	1897	
1920	130	422	92	52	30	566	85	15.0	999	71848	1649	

will be indicated by determining among reported cases the interval of time elapsing between the dates of reporting and death. According to an analysis by Miss LaMotte, in 1912, of the 1,189 deaths from pulmonary tuberculosis in the city, 856 were among cases on the visiting-lists. Among these 856, deaths occurred within—

1 month after reporting	188	or 22	per cent.
First and second month after reporting	115	or 13.4	per cent.
Second and third month after reporting	68	or 8	per cent.
Third and fourth month after reporting	73	or 8.5	per cent.
Within 4 months after reporting	444	or 51	per cent.
Within 1 year after reporting	635	or 77	per cent.
Within first and second year after reporting	114	or 13	per cent.
Within second and third year after reporting	87	or 10	per cent.

These figures were thought to support the claim of the nurses that reporting was not only delayed, but very incomplete.

At the instance of the writer, in 1916, the deaths from pulmonary tuberlosis which occurred during that year among cases upon the visiting-lists were analyzed according to the time which elapsed since they were reported. The results are presented in tables 89 and 90. The 980 cases analyzed included the

TABLE 89.—*Distribution of deaths in 1916 from pulmonary tuberculosis, according to years in which the decedents were reported as cases.*

Years.	Total.		White.		Colored.	
	No. of cases dying.	Per cent of total.	No. of cases dying.	Per cent of total.	No. of cases dying.	Per cent of total.
1910	35	3.6	31	4.6	4	1.3
1911	13	1.3	9	1.3	4	1.3
1912	31	3.1	29	4.3	2	0.7
1913	50	5.0	44	6.6	6	1.9
1914	70	7.1	56	8.4	14	4.5
1915	282	28.8	208	31.0	74	24.0
1916	498	50.8	293	43.7	205	66.3
Total	980	100	671	100	309	100

TABLE 90.—*Time elapsing between data of report and date of death of cases of pulmonary tuberculosis reported and dying during 1916.*

Time.	Total.		White.		Colored.	
	No. of cases dying.	Per cent of total.	No. of cases dying.	Per cent of total.	No. of cases dying.	Per cent of total.
Under 1 week	73	14.8	43	14.7	30	14.9
Between 1 and 2 weeks	59	11.9	34	11.6	25	12.4
Between 2 and 4 weeks	91	18.4	47	16.0	44	21.8
1 to 2 months	94	19.0	48	16.4	46	22.8
2 to 3 months	57	11.5	29	9.9	28	13.9
Under 3 months	374	75.6	201	68.6	173	85.8
3 to 4 months	43	8.7	32	10.9	11	5.5
4 to 6 months	46	9.3	33	11.3	13	6.4
Under 6 months	463	93.6	266	90.8	197	97.7
6 to 9 months	28	5.7	23	7.9	5	2.5
9 to 12 months	4	0.8	4	1.4	.....	.....
Total	495	100	293	100	202	100

deaths occurring among listed cases at the three extra-urban sanatoria. It will be observed (table 89) that 50.8 per cent of the deaths were among cases reported during 1916 and 28.8 per cent among cases reported in 1915, leaving slightly over 20 per cent reported as cases during the remaining 5 years from 1910 to 1914, inclusive. Among this latter group, the proportions which had been reported in each particular year steadily diminished from 1914 to 1911. As between whites and negroes, the proportions as expressed in percentages were 43.7 and 66.3 for 1916, and 31 and 24, respectively, for 1915. It is noteworthy that of individuals dying in 1916, a very much larger percentage among whites than among negroes had been reported as cases in previous years.

Considering now the 495 deaths that occurred among cases reported during 1916 (table 90), it is found that in a large proportion of instances death took place within a few weeks after reporting. In over 75 per cent the cases had been reported only 3 months, and in 93.6 per cent only 6 months before death. The period elapsing between reporting and death was uniformly shorter for negroes than for whites. The number of deaths between the sixth and the twelfth month after reporting was insignificant. Considered alone, the data in table 90 suggest very strongly that case reporting was, as claimed by the nurses, in many instances willfully delayed, with the result that many cases of pulmonary tuberculosis were brought under observation and instruction much later than the law contemplated. In support of this point there are two main arguments: First, that there is strong circumstantial evidence that some physicians have in certain instances delayed case reporting until it was evident that a fatal issue must soon ensue and further concealment would expose them to prosecution when a certificate for death of an unreported case of pulmonary tuberculosis was presented; second, that both in general and in comparison with certain other cities (New York and Manchester, for instance) the morbidity-rates as compared with the mortality-rates are relatively low. In reply to these it is to be said, that such instances of willfully delayed reporting are relatively rare; the majority of all cases are not reported by physicians, but by dispensaries and other charitable agencies where the motive for concealment is lacking; the proportion of early deaths after reporting is higher in negroes, among whom the great mass of cases are reported by such agencies and not by private physicians; since 1916, at least, physicians have withheld consent to visit in but a small proportion of cases reported by them; and for over 5 years the city had been dragnetted for cases of tuberculosis by the health department nurses and by charitable agencies and but a very small proportion of the large number of contacts with known cases submitted to medical examination were proved to be clinical cases of tuberculosis.

In the light of these considerations more adequate explanation must be sought. Since it is clear that the phenomenon under discussion can not, in the nature of the case, in any considerable measure be due to willfully delayed reporting, its true explanation must be sought in the natural history of the disease and the reaction of its victims. In the discussion of the morbidity-curve two significant points pertinent in this connection were established, namely, that, since 1910, recognized cases must have been reported with a fair degree of completeness and morbidity- and mortality-rates have had such a constant ratio to each other that their simultaneous rise and fall must be due to the operation of the same cause or causes. It appears from tables 89 and

90 that the time elapsing between case reporting and death is conspicuously shorter for negroes than for whites, and it is well established that the morbidity- and mortality-rates were higher and the disease on the whole runs a shorter course in the former than in the latter. It was found that on a particular day in 1915 the "advanced-stage" group constituted 21 per cent of the whole number of listed positive cases. It may be safely assumed that on an average from 18 to 25 per cent of all registered cases fall in this category, and it is evident that it is from this group that the bulk of the fatal cases must come. The group "advanced-stage" reported cases can originate in only two ways, either by decline from the stage next above, the "moderately advanced stage," or by entering the lists as "advanced-stage" cases at the time of reporting. The movement of moderately advanced cases is slow, and cases of this group remain stationary, become arrested, become chronic, or go into the "advanced stage." Those that pursue the latter course are the less resistant and probably usually change from the higher to the lower stage shortly after being reported. The numbers of the "advanced-stage" group reported in this stage of the disease may represent either cases of phthisis florida, or the not small class of persons with pulmonary tuberculosis in moderately advanced stages without clinical symptoms definite enough to cause them to seek medical advice until after a sudden decline in health, when the disease has rapidly reached the advanced stage.

When the question is considered in the light of the ascertained facts and the inferences that flow from them, it becomes evident that in the nature of the case, in a large proportion of instances of fatal pulmonary tuberculosis death should occur within a comparatively short period after case reporting. Here is brought into prominence a fundamental fact only too frequently ignored by the untrained, namely, that there is often a vast difference between the date of real incidence and the date at which a case of phthisis is likely to attain the stage of reporting. On the whole, it seems probable that in the period under review a very considerable proportion of those who developed active pulmonary tuberculosis have not, for one reason or another, exposed themselves to the conditions that lead to diagnosis and reporting until the disease is well advanced, and that the relatively low recorded morbidity-rate as compared with the mortality-rate has been due to this circumstance rather than to neglect on the part of physicians to report their cases promptly. In view of the failure of the active measures directed over so many years to the earlier recognition of the disease, it is unlikely that anything short of compulsory physical examination, repeated at short intervals, of every individual in the community would materially change the recorded incidence of the disease.

It has long been held by physicians that attacks of certain acute infectious diseases, notably measles, scarlet fever, whooping-cough, typhoid fever, and pneumonia, predispose to tuberculosis. In a general way, the mortality-rates for tuberculosis, and for all of these diseases except pneumonia, have declined together since 1880. To the degree that lowered death-rates indicate either decreased incidence of these diseases or slighter injury to those who survive attacks, it is possible that this association may be significant. On a parity of reasoning, the decline and practical disappearance during this period of smallpox and malaria and typhus fever, all of which severely tax the system, may

have exerted a favorable influence upon the tuberculosis-rate. The period of high mortality for pulmonary tuberculosis between 1840 and 1880 was characterized by high rates for nearly all of these diseases. On the other hand, the fall in the rates for pulmonary tuberculosis which took place between 1820 and 1840 occurred when the rates for the insect-borne diseases were particularly high, though falling. There is a distinct though not uniform correspondence in the curve of the rates for tuberculosis and the diarrhœal diseases, and particularly for those for dysentery and cholera. The curves for pneumonia and pulmonary tuberculosis do not in general correspond very closely.

What effects upon the morbidity- and mortality-rates may be attributed to the specific efforts put forth by administrative authority? As judged by the mortality-rate, there was no appreciable effect. The total death-rate was lower in 1899 before anything was done than it was in any year until 1915. After 1899 there was a moderate wave of increase in the rates, which, reaching a peak in 1904, had in its decline attained by 1910 the level of 1900. The anti-spitting law can hardly be given the credit for this slight reaction. During the first 4 years of the existence of the tuberculosis division, the mortality-rate, when the deaths among Baltimore cases dying at the extra-urban sanatoria are taken into account, remained practically on a level. The slight drop in 1915 to the level of 1899 was not maintained. In spite of additional nurses and increased activity during the next 3 years, the rate rose steadily to the level of 1905, or to a point nearly as high as was attained at the peak of the last wave, and considerably higher than in 1899. Upon case reporting legal enactments had but small effect until the establishment of the tuberculosis division in 1910. It has been shown that the enormously high morbidity-rates recorded between 1910 and 1912 were due to the registration of large numbers of cases previously known and in no proper sense represented actual current newly recognized cases. The morbidity-curve, which since 1913 may justly be regarded as representing the current morbidity as judged by the standard of reporting in vogue, rises and falls in strict consonance with the curve for mortality. The sudden fall in both mortality- and morbidity-rates since 1918, a duplication of a phenomenon characteristic of many American cities since the great influenza epidemic, can hardly be attributed to the anti-tuberculosis activities. Mortality-rates in Baltimore have moved in the same manner, though in less degree, after other influenza epidemics. These occurrences suggest the query, whether an attack of influenza does not protect against tuberculosis.

In the period 1910–1918, the nursing force had charge of from two-thirds in the early period to four-fifths in the latter period of all known cases of the disease for instruction in prophylaxis. During much of the period not less than 15 nor more than 20 per cent of the cases of the moderately advanced and something like 30 per cent of the cases of the advanced stage were hospitalized, the former for curative treatment and the latter for isolation alone. So far as benefits derived from instruction in prophylaxis are concerned, of the active cases on the visiting-lists in 1915, a typical year, 17 per cent were recorded as adequately careful, 41 per cent as moderately careful, and 42 per cent as careless. In nearly half the cases the results of instruction were regarded as *nihil*. It is safe to assume that the cases remaining exclusively

under the instruction of their attending physicians were, on the whole, supervised and instructed at least as thoroughly and conscientiously as were those visited by the nurses. Nor can prophylactic effects of any considerable value be expected from fumigations of dwellings at the termination of the illness or on removal of individuals, who for weeks, months, or even years had been emitting myriads of tubercle bacilli daily.

It is evident from table 88 that the part played by the tuberculosis dispensaries of the health department in diagnosis and treatment was relatively negligible. The only other special dispensaries for tuberculosis during this period, Phipps and the University of Maryland, represented after all only separate divisions of medical clinics long in operation. Similarly, the opening of the Municipal Tuberculosis Hospital on Bay View grounds did not amount to a great deal more than the segregation in a separate building of about the same annual number of advanced cases of pulmonary tuberculosis that in former years was received in the almshouse and infirmary of the same institution. The three extra-urban sanatoria were indeed new institutions opened since 1908. Adequate data for measuring accurately their influence upon the course of pulmonary tuberculosis in Baltimore are not available. An average annual hospital death-rate of 17 per cent among the selected cases admitted does not suggest that their favorable influence was striking.

In regard to other forms of tuberculosis from 1875 when the classification of deaths under this heading first approached accuracy, the averaged rates for the whole population fell steadily until 1895. During the next 5 years they reacted to a somewhat higher level, which was maintained with slight variations until 1920. In the 20-year period from 1901 to 1920, on the whole, the rates for whites declined and those for negroes rose. The rates for females were distinctly lower than those for males in both races. The rates for this rubric declined sharply after the influenza epidemic. There was no significant response to the sanitary improvements which characterized this period, unless some of the decline since 1918 may be attributable to the pasteurization of the milk-supply. So far as may be judged from the data at hand, the action of the force of mortality in tuberculosis of the lungs and of other organs was strikingly similar.

Advances and declines in the death-rates for the population as a whole have been influenced less by rapid growth in the population *per se* than by changes in the relative proportions of certain race stocks. The mortality-rate has been considerably higher in negroes than in whites and has risen with the increase and fallen with the decrease in the proportion of Irish and Germans in the population. The rate has declined notably with the influx of Jews, Italians, and Poles. The evidence that the mortality-rate was influenced by financial depression and by prosperity is conflicting. On the whole, the balance of the evidence is in favor of the view that it was unfavorably affected by financial depression. It is more than possible that increase in the quantity of the milk-supply since 1880 may have exerted a favorable influence. Whereas the mortality-rate did decline synchronously with sanitary improvements at certain times, e. g., after the water-supply, sewerage disposal, paving, and the like had undergone distinct improvements between 1820 and 1840, and the water-supply again after 1865, and after 1880, this must apparently be attributed to other causes, for there was, on the whole, no significant decline in the annual mortality-rates in this period from 1900 to 1918, during which time the most

extensive improvements were made in general sanitation, in regard to water, sewage, garbage collection, and general nuisance control, paving, milk inspection, federal inspection of meats and the anti-spitting ordinance. While in this analysis it has not been possible to determine any positive beneficial effects upon the tuberculosis mortality-rate to be ascribed to the in many ways profound and far-reaching modifications of environment, which have included every extreme except those induced by siege and famine, the possibility or even probability of a negative influence may not be denied. For instance, it can not be claimed that, in the absence of the general sanitary reforms and the restrictive and educational measures directed specifically against tuberculosis introduced after 1895, and which reached their climax about 1918, the waves of higher rates which were due and which actually started after 1899 and 1912 would not have reached much higher levels than were attained.

There are rather definite indications which suggest that the course of tuberculosis has been influenced unfavorably by attacks on the community of certain acute communicable diseases and affected favorably by the decline in the virulence of some and the practical disappearance of others.

Whatever the causes of the decline in the mortality from pulmonary tuberculosis may be, they have acted uniformly as to time, though not in the same degree, upon males and females in both the white and colored races. Since about 1880, the curves for both races have followed almost identical courses, though at different levels. In periods of decline, in both races the rates for females have fallen more sharply than those for males. While with the decline in the rates for all ages in each category, the rates for each age-group have dropped, the decrease in mortality has been most conspicuous in the age-groups before the thirtieth year of life. The available data indicate that in regard to color and sex the age distribution of reported cases and deaths has been in close accord.

These close associations suggest very strongly that the causes which control both incidence and fatality of pulmonary tuberculosis and which act in the same manner though in such different degree in both races and sexes are fundamentally biological. However, this may be, the only positive evidence adduced indicates unmistakably that the rise and fall in the rate for tuberculosis in Baltimore during the 109 years embraced in this study have been determined above all other factors by natural selection, and that in this struggle between parasite and host under very varied and complex changes of terrain as represented by environment, and of the belligerents themselves as represented by recruits, in the shape of new races as well as by discipline and training, the advantage has been sometimes with the one and sometimes with the other. In these respects tuberculosis has behaved in many, if not in most ways like several other readily communicable diseases whose courses have been followed in this work. In 1917, on the basis of data presented in this chapter, the writer was forced to the conclusion that the real significance of the various factors concerned in human tuberculosis can not be ascertained with the incomplete and superficial knowledge, relatively inaccurate methods, and the illogical reasoning hitherto so commonly brought to bear upon the question. Nothing short of an exhaustive study of the genetic and environmental history of a very large number of cases promised a solution, and in 1919, at the writer's suggestion, Professor Raymond Pearl undertook such an investigation of the Baltimore material.

Chapter XII.—Other Acute Febrile Diseases, Some Apparently Contactive.

Acute meningitis; Poliomyelitis; Tetanus; Erysipelas; Appendicitis.
(Tables 91 to 100 and 34, 128, 131.)

ACUTE MENINGITIS.

In the local statistical nosology, the rubric cerebro-spinal meningitis appeared in 1872, coincident with an outbreak of the so-called epidemic meningitis. Three years later the rubrics meningitis and tuberculous meningitis were added. Before 1872 meningitis of various types was probably classfied for the most part under such indefinite headings as inflammation of the brain, dropsy of the brain, and convulsions, and probably not until 1900 were deaths due to inflammation of the meninges classified with approximate precision under the appropriate rubrics. Of the affections most likely to be confused with acute meningitis, the most prominent are brain tumor, brain abscess, uræmia, and the intoxications of certain acute infectious diseases, such as typhoid fever and pneumonia. The first specific type of acute meningitis to be recognized anatomically and etiologically with certainty was the tuberculous. Though this form has been included in the discussion of tuberculosis, it will be necessary to allude to it here. Of non-tuberculous acute meningitis three types may be recognized: The specific disease due to meningococcus intracellularis meningitidis, the so-called epidemic meningitis, which is not infrequently sporadic also; primary meningitis of other but very diverse etiology, caused for the most part by the pyogenic cocci, but occasionally by other identified micro-organisms and by unknown causes; and secondary meningitis occurring as a complication of wound infection, endocarditis, arterial and venous thrombosis, middle-ear disease, brain abscess, typhoid fever, pneumonia, the eruptive diseases, and injuries of various kinds, particularly of the skull. It is manifest that these types were not differentiated in the statistical classification and that meningitis and cerebro-spinal meningitis must have included the epidemic type, primary and secondary non-tuberculous meningitis of other etiology, and some deaths from tuberculous meningitis.

It is probable that fewer mistakes were made in the classification of deaths from tuberculous meningitis, and that, on the whole, the figures for this rubric since 1880 reflect actual occurrence with a fair degree of accuracy. It is likely that, particularly in times of epidemic outbreaks, the specific meningococcus meningitis was as a rule classified under the rubric cerebro-spinal meningitis. The rubric meningitis, which has carried the largest proportion of the deaths ascribed to acute inflammation of the meninges, has undoubtedly included many of the deaths from meningococcus meningitis, some deaths due to tuberculosis, and most of those due to primary and secondary meningitis of other causation. The annual mortality from meningitis, as classified under those various headings, with the total mortality from all forms and from meningitis and cerebro-spinal meningitis combined, is presented in table 91. It

will be noted that the rates for tuberculous meningitis, beginning with 27 in 1875, attained 33, its highest level, in 1877, and fell gradually by somewhat irregular steps to 15 in 1885. After holding about this level during the next 4 years and rising to 22 in 1890, it ran an uneven course, with rates varying between 11 and 17, until 1904. With the exception of 1905 and 1911, when the rates were 6 and 15, respectively, the annual rate varied between 10 and 13 until 1919. In the latter year it was 9, and in 1920 it fell to 5. The fluctuation in the annual rate was not wide and did not synchronize with changes in the rate for the other rubrics. On the whole, the impression is given of an independent disease with rates falling gradually, though somewhat irregularly, from a peak in 1879 to a relatively low level by 1920.

While the number of deaths ascribed to cerebro-spinal meningitis fell far short of the whole number that must have been caused by epidemic or meningococcus meningitis, it is probable that the rates reflect, with some accuracy, the general course of that disease as measured in terms of mortality. It would appear that this affection was present each year between 1872 and 1910, and that upon the endemic basis that followed the epidemic beginning about 1872, the course of the disease has been marked by several exacerbations, or epidemic outbreaks, the severest of which were those of 1881–1883, 1898–1900, and 1917–1918. Between 1910 and 1912, inclusive, the affection apparently died out. The outbreak of 1917–1918, which fell under the writer's observation, during which all reported cases were investigated bacteriologically, was shown to be due to meningococcus intracellularis meningitidis.

The rates for the rubric meningitis, supposedly representing chiefly deaths from primary and secondary meningitis of other origin than the tuberculous and the meningococcus forms, are markedly higher than those for these other rubrics. As compared with the other two rubrics, its course manifests a certain degree of correlation in that very commonly years in which it registered higher rates synchronized with years of lower rates for one or for both of the others, and years of rising rates for them showed lower or falling rates for it. This picture suggests that, to some degree at least, the fluctuation in the rates for these three rubrics was determined by statistical classification. However, this may be, the rates for meningitis rose from 26 in 1875 to 39 in 1879, and, holding at about the latter level for the next two years, ascended to 47 in 1881. Falling by uneven steps during the succeeding 6 years, the rate stood at 34 in 1887, and from this it rose in 1892 to 49, the highest point attained. From this date the trend of the curve is downward. The annual rate was never as high as 40 after 1898, 25 after 1902, nor 20 after 1910. Since 1912 the rate has declined steadily to 3 in 1920.

The sum of the rates for meningitis and cerebro-spinal meningitis may be regarded as in the main representative of the death-rates for non-tuberculous meningitis. If this be true, the tuberculous form has been, during most of the period under consideration, a relatively unimportant cause of death. The curve of the rates for non-tuberculous meningitis, after holding a high level—between 40 and 58 from 1875 to 1901—fell continuously to the low level of 6 in 1920. The rate for tuberculous meningitis had by 1900 fallen to 11, which was maintained on an average until 1919, without any significant further fall.

TABLE 91.—*Number of deaths and rate of death, per 100,000 living inhabitants, from erysipelas, tetanus and acute diseases of central nervous system, from 1812 to 1920, inclusive.*

D = death. R = rate.

Year.	Erysipelas.		Tetanus.		Acute diseases of the central nervous system.																					
					Total.		Total (excluding tuberculous meningitis).		Dropsy in head.		Inflammation of brain.		Spinal affections and dropsy of spine.		Meningitis.										Poliomyelitis.	
															Meningitis.		Cerebro. spinal.		Total.		Tuberculous.		All forms.			
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1812	...	...	3	7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1813	...	...	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1814	1	2	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1815	3	6	3	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1816	10	20	2	4	5	10	5	10	3	6	2	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1817	4	8	2	4	6	12	6	12	6	12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1818	2	4	3	6	32	60	32	60	18	34	14	26	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1819	...	...	2	4	37	67	37	67	27	49	10	18	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1820	...	...	4	7	15	26	15	26	8	14	7	12	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1821	...	...	3	5	54	90	54	90	32	53	22	36	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1822	1	2	3	5	47	75	47	75	33	53	14	22	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1823	2	3	1	2	53	81	53	81	38	58	15	23	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1824	...	...	4	6	34	50	34	50	21	31	13	19	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1825	...	...	3	4	10	14	10	14	...	...	10	14	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1826	...	...	2	3	12	16	12	16	...	...	12	16	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1827	...	...	1	1	41	53	41	53	28	37	13	17	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1828	...	...	2	3	52	65	52	65	33	42	19	24	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1829	...	...	2	2	57	69	57	69	41	50	16	19	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1830	...	...	5	6	48	56	48	56	34	40	14	16	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1831	1	1	4	5	54	61	54	61	33	37	21	24	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1832	1	1	5	5	59	64	59	64	41	45	18	20	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1833	3	3	4	4	99	104	99	104	48	50	51	53	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1834	1	1	3	3	79	80	79	80	44	44	35	35	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1835	4	4	2	2	65	63	65	63	44	43	21	21	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1836	...	...	4	4	53	50	53	50	34	32	19	18	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1837	...	...	3	3	72	66	72	66	34	31	38	35	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1838	1	1	2	2	68	60	68	60	43	38	25	22	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1839	4	3	3	3	61	52	61	52	26	22	35	30	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1840	...	...	1	1	81	67	81	67	63	52	18	15	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1841	...	...	1	1	91	73	91	73	64	51	27	22	...	...	...	...	...	...	...	...	...	...	...	...	...	...

1842	3	2	5	4	70	54	70	54	47	36	23	18	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1843	5	4	4	3	89	67	89	67	55	41	34	26	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1844	...	...	3	2	84	61	84	61	50	36	34	25	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1845	4	3	1	1	92	65	92	65	46	33	46	33	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1846	14	10	3	2	73	50	73	50	39	27	34	23	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1847	9	6	2	1	89	59	89	59	...	...	89	59	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1848	10	6	5	3	83	54	83	54	...	...	83	54	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1849	19	12	6	4	172	108	172	108	105	66	67	42	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1850	32	20	4	2	239	146	239	146	122	74	112	68	5	3	...	...	...	...	...	...	...	...	...	...	...	...
1851	19	11	1	1	238	141	238	141	120	71	104	62	14	8	...	...	...	...	...	...	...	...	...	...	...	...
1852	12	7	6	3	263	152	263	152	118	68	134	77	11	6	...	...	...	...	...	...	...	...	...	...	...	...
1853	22	12	2	1	219	123	219	123	45	25	164	92	10	6	...	...	...	...	...	...	...	...	...	...	...	...
1854	9	5	3	2	290	158	290	158	165	90	115	63	10	5	...	...	...	...	...	...	...	...	...	...	...	...
1855	17	9	5	3	281	149	281	149	87	46	187	99	7	4	...	...	...	...	...	...	...	...	...	...	...	...
1856	24	12	3	2	238	123	238	123	74	38	153	79	11	6	...	...	...	...	...	...	...	...	...	...	...	...
1857	19	10	4	2	244	123	244	123	76	38	155	78	13	7	...	...	...	...	...	...	...	...	...	...	...	...
1858	17	8	5	2	249	122	249	122	90	44	146	72	13	6	...	...	...	...	...	...	...	...	...	...	...	...
1859	10	5	6	3	245	117	245	117	95	45	143	68	7	3	...	...	...	...	...	...	...	...	...	...	...	...
1860	9	4	1	...	237	111	237	111	85	40	138	64	14	7	...	...	...	...	...	...	...	...	...	...	...	...
1861	18	8	6	3	253	115	253	115	112	51	128	58	13	6	...	...	...	...	...	...	...	...	...	...	...	...
1862	12	5	...	...	199	88	199	88	76	34	117	52	6	3	...	...	...	...	...	...	...	...	...	...	...	...
1863	34	15	9	4	168	73	168	73	32	14	126	55	10	4	...	...	...	...	...	...	...	...	...	...	...	...
1864	26	11	6	3	254	107	254	107	32	14	210	89	12	5	...	...	...	...	...	...	...	...	...	...	...	...
1865	34	14	7	3	208	86	208	86	46	19	149	61	13	5	...	...	...	...	...	...	...	...	...	...	...	...
1866	17	7	12	5	238	96	238	96	87	35	135	54	16	6	...	...	...	...	...	...	...	...	...	...	...	...
1867	15	6	3	1	261	103	261	103	111	44	140	55	10	4	...	...	...	...	...	...	...	...	...	...	...	...
1868	15	6	6	2	303	116	303	116	94	36	197	76	12	5	...	...	...	...	...	...	...	...	...	...	...	...
1869	20	8	11	4	344	129	344	129	113	42	221	83	10	4	...	...	...	...	...	...	...	...	...	...	...	...
1870	20	7	9	3	347	127	437	127	114	42	208	76	25	9	...	...	...	...	...	...	...	...	...	...	...	...
1871	24	9	12	4	401	144	401	144	93	33	283	101	25	9	...	...	...	...	...	...	...	...	...	...	...	...
1872	41	14	13	5	508	178	508	178	103	36	292	102	57	20	...	...	56	20	56	20	...	...	56	20	...	...
1873	48	16	12	4	424	145	424	145	70	24	241	83	58	20	...	...	55	19	55	19	...	...	55	19	...	...
1874	46	15	13	4	385	129	385	129	58	19	257	86	40	13	...	...	30	10	30	10	...	...	30	10	...	...
1875	53	17	50	16	337	110	254	83	54	18	52	17	16	5	79	26	53	17	132	43	83	27	215	70	...	...
1876	28	9	55	18	308	99	211	68	41	13	60	19	11	4	74	24	25	8	99	32	97	31	196	63	...	...
1877	25	8	45	14	377	118	271	85	48	15	68	21	9	3	122	38	24	8	146	46	106	33	252	79	...	...
1878	36	11	57	18	329	102	226	70	41	13	33	10	...	...	126	39	26	8	152	47	103	32	255	79	...	...
1879	29	9	43	13	312	95	234	71	39	12	29	9	1	...	127	38	38	11	165	50	78	24	243	74	...	...
1880	23	7	62	18	339	100	238	70	55	16	31	9	...	...	126	37	26	8	152	45	101	30	253	75	...	...
1881	39	11	80	23	351	101	278	80	48	14	31	9	...	...	162	47	37	11	199	58	73	21	272	79	...	...
1882	35	10	58	16	317	90	247	70	29	8	29	8	...	...	151	43	38	11	189	54	70	20	259	74	...	...
1883	32	9	49	14	329	92	266	74	39	11	37	10	...	...	148	41	42	12	190	53	63	18	253	71	...	...
1884	33	9	59	16	294	80	218	59	19	5	24	7	...	...	155	42	20	5	175	48	76	21	251	69	...	...
1885	47	13	38	10	274	74	219	59	25	7	22	6	...	...	148	40	24	6	172	46	55	15	227	61	...	...
1886	32	8	47	12	295	77	233	61	32	8	31	8	...	...	146	38	24	6	170	45	62	16	232	61	...	...

TABLE 91.—*Number of deaths and rate of death, per 100,000 living inhabitants, from erysipelas, tetanus and acute diseases of central nervous system, from 1812 to 1920, inclusive.*—Continued.

Year.	Erysipelas.		Tetanus.		Acute diseases of the central nervous system.																					
					Total.		Total (excluding tuberculous meningitis.)		Dropsy in head.		Inflammation of brain.		Spinal affections and dropsy of spine.		Meningitis.										Poliomyelitis.	
															Meningitis.		Cerebro-spinal.		Total.		Tuberculous.		All forms.			
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1887	35	9	51	13	265	68	198	51	26	7	21	5	...	...	132	34	19	5	151	39	67	17	218	56	...	...
1888	30	7	61	15	307	73	237	56	17	4	32	8	...	...	166	40	22	5	188	45	70	17	258	62	...	...
1889	36	8	50	12	307	72	244	57	21	5	29	7	...	...	176	41	18	4	194	45	63	15	257	60	...	...
1890	25	6	47	11	346	80	252	58	18	4	43	10	...	...	160	37	31	7	191	44	94	22	285	66	...	...
1891	15	3	43	10	309	70	253	57	20	5	44	10	...	...	171	39	18	4	189	43	56	13	245	56	...	...
1892	24	5	58	13	404	90	327	73	23	5	45	10	...	...	222	49	37	8	259	58	77	17	336	75	...	...
1893	26	6	42	9	346	76	281	62	16	4	21	5	...	...	185	41	59	13	244	53	65	14	309	67	...	...
1894	22	5	55	12	332	72	258	56	19	4	37	8	...	...	176	38	26	6	202	44	74	16	276	60	...	...
1895	24	5	47	10	294	63	230	49	21	4	22	5	...	...	160	34	27	6	187	40	64	14	251	54	...	...
1896	22	5	57	12	341	71	274	57	25	5	30	6	...	...	187	39	32	7	219	46	67	14	286	60	...	...
1897	28	6	37	8	306	63	236	49	14	3	19	4	...	...	181	37	22	5	203	42	70	14	273	56	...	...
1898	19	4	37	8	361	73	293	59	10	2	13	3	...	...	197	40	73	15	270	55	68	14	338	69	...	...
1899	21	4	17	3	352	71	289	58	21	4	10	2	...	...	178	36	80	16	258	52	63	13	321	65	...	...
1900	21	4	10	2	292	57	234	46	12	2	5	1	...	...	124	24	93	18	217	43	58	11	275	54	...	...
1901	41	8	26	5	227	44	171	33	...	...	7	1	...	...	136	26	28	5	164	32	56	11	220	43	...	...
1902	21	4	26	5	216	42	160	31	...	...	...	...	...	...	131	25	29	6	160	31	56	11	216	42	...	...
1903	26	5	19	4	220	42	152	29	...	...	5	1	...	...	118	22	29	6	147	28	68	13	215	41	...	...
1904	25	5	24	4	218	41	149	28	...	...	3	1	...	...	113	21	33	6	146	27	69	13	215	40	...	...
1905	19	4	20	4	185	34	150	28	...	...	6	1	...	...	114	21	30	6	144	27	35	6	179	33	...	...
1906	23	4	27	5	232	42	164	30	...	...	1	...	...	...	134	24	29	5	163	30	68	12	231	42	...	...
1907	17	3	21	4	218	40	164	30	...	...	3	1	...	...	109	20	52	9	161	29	54	10	215	39	...	...
1908	26	5	15	3	214	38	146	26	...	...	6	1	...	...	115	21	25	4	140	25	68	12	208	37	...	...
1909	22	4	19	3	171	30	106	19	...	...	1	...	...	...	97	17	8	1	105	19	65	11	170	30	...	...
1910	36	6	16	3	189	33	129	23	...	...	8	1	...	...	121	21	...	...	121	21	60	10	181	31	...	...
1911	27	5	23	4	190	33	103	18	...	...	2	...	...	...	101	17	...	...	101	17	87	15	188	32	...	...
1912	23	4	32	5	192	33	112	19	...	...	2	...	...	...	110	19	...	...	110	19	74	13	184	32	6	...
1913	23	4	16	3	174	29	97	16	...	...	9	2	...	...	75	13	13	2	88	15	76	13	164	28	1	...
1914	28	5	16	3	129	21	67	11	...	...	6	1	...	...	47	8	14	2	61	10	60	10	121	20	2	...
1915	18	3	12	2	100	18	42	7	...	...	2	...	...	...	34	6	6	1	40	7	58	10	98	17	4	1
1916	27	4	8	1	183	30	57	9	...	...	8	1	...	...	31	5	18	3	49	8	56	9	105	17	70	12
1917	28	5	11	2	149	24	80	13	...	...	...	...	...	...	22	4	58	9	80	13	69	11	149	24	...	...
1918	21	3	7	1	167	27	91	15	...	...	2	...	...	...	14	2	75	12	89	14	71	11	160	25	5	1
1919	19	3	7	1	140	24	76	11	...	...	14	2	...	...	23	3	39	5	62	9	64	9	126	18	28	4
1920	24	3	14	2	89	13	50	7	...	...	6	1	...	...	19	3	25	3	44	6	39	5	83	11	4	1

The sum of the rates for the three rubrics indicates with some degree of accuracy the course of the mortality for the acute infections inflammatory affections of the cerebro-spinal meninges during the 46 years under consideration. During the first 25 years the course of the curve of mortality varied between 79 and 54. Between 1900 and 1915 the rates fell almost without interruption from 54 to 17. During the next 3 years, owing to a recrudescence of epidemic meningitis, the rate rose to 25, to fall to 18 in 1919 and to 11 in 1920.

When the irregular annual fluctuations in the rates for these three rubrics are smoothed by averaging for 5-year periods (table 92), very much the same

TABLE 92.—*Average rate of death, per 100,000 living inhabitants, by 5-year periods, from acute diseases of the central nervous system, from 1812 to 1920, inclusive.*

Periods.	Meningitis.					Poliomyelitis.	Dropsy in the head.	Inflammation of the brain.	Spinal affections and dropsy of the spine.	Total, excluding tuberculous meningitis.	Grand total.
	Meningitis.	Cerebro-spinal.	Total.	Tuberculous.	All forms.						
1812-15	...	...	...	...	...	...	...	...	...	...	...
1816-20	...	...	...	...	...	...	23	12	...	35	35
1821-25	...	...	...	...	...	...	39	23	...	62	62
1826-30	...	...	...	...	...	...	33	19	...	52	52
1831-35	...	...	...	...	...	...	44	31	...	74	74
1836-40	...	...	...	...	...	...	35	24	...	59	59
1841-45	...	...	...	...	...	...	40	24	...	64	64
1846-50	...	...	...	...	...	...	33	49	1	83	83
1851-55	...	...	...	...	...	...	60	79	6	145	145
1856-60	...	...	...	...	...	...	41	72	6	119	119
1861-65	...	...	...	...	...	...	26	63	5	94	94
1866-70	...	...	...	...	...	...	40	69	6	114	114
1871-75	...	18	18	5	23	...	26	78	14	136	141
1876-80	35	9	44	30	74	...	14	14	1	73	103
1881-85	43	9	52	19	71	...	9	8	...	68	87
1886-90	38	6	44	17	61	...	6	8	...	57	74
1891-95	40	7	47	15	62	...	4	7	...	59	74
1896-1900 ...	35	12	47	13	60	...	3	3	...	54	67
1901-05	23	6	29	11	40	...	...	1	...	30	41
1906-10	21	4	25	11	36	...	...	1	...	25	36
1911-15	13	1	14	12	26	...	...	1	...	15	27
1916-20	3	7	10	9	19	3	...	1	...	14	23

picture is obtained. The averaged rate for tuberculous meningitis fell from 30 in 1876–1880 to 19 in 1881–1885, to 13 in 1896–1900, and to 11 in 1901–1905. Between 1900 and 1920 it remained almost constant, and the slight drop during the last 5 years is hardly significant. The averaged rate for cerebro-spinal meningitis fell from its high level of 18 in 1871–1875 to 9 in 1876–1880, remained unchanged during the next 5 years, and between 1886 and 1890 dropped to 6. Ascending to 12, a second high level between 1891 and 1900, the averaged rate descended continuously to 1 between 1911 and 1915. From 1916 to 1920 the rates averaged 7. The averaged rate for meningitis, unqualified or so-called simple meningitis, which was 35 for the period ending in 1880, rose to 43 for the next 5 years. Varying but slightly

from this level from 1886 to 1895 it returned to the initial level of 35 between 1896 and 1900. From 1901 to 1920 the rate declined steadily to 3. It will be noted that simple meningitis and cerebro-spinal meningitis fell together between 1901 and 1915, and that between 1916 and 1920 the former continued to fall uninterruptedly, while the latter rose. Since 1900, in the statistical nosology, the latter has represented the meningococcus form and the former acute non-tuberculous meningitis of other etiology. This separation was made with reasonable clearness from 1900 to 1915 and with considerable accuracy between 1916 and 1920. Therefore, the course of the curves for these two rubrics during the past 20 years may be taken to represent the respective lethal importance of these two types of meningitis. The curve of the averaged rates for these two types taken together rose steadily from 18 for

TABLE 93.—*Number of cases and monthly annual rate of morbidity, per 100,000 living inhabitants, from epidemic (meningococcus) meningitis, from 1916 to 1920, inclusive.*

C = cases. R = rate.

	1916		1917		1918		1919		1920	
	C	R	C	R	C	R	C	R	C	R
Jan.	1	2	...	...	13	25	14	23	4	6
Feb.	...	...	...	...	23	49	14	25	4	7
Mar.	...	...	17	33	27	51	6	10	6	10
Apr.	3	6	20	40	36	71	4	7	4	7
May	1	2	37	71	19	36	1	2	4	6
June	...	...	23	46	8	16	4	7	4	7
July	3	6	5	10	13	25	4	7	2	3
Aug.	4	8	2	4	8	15	10	16	3	5
Sept.	...	...	2	4	5	10	1	2	...	...
Oct.	2	4	2	4	8	15	3	5	...	...
Nov.	...	...	7	14	10	20	3	5	2	3
Dec.	2	4	7	13	5	10	4	7	3	5
Total	16	3	122	20	175	28	68	9	36	5
Percentage case fatality			48		43		57		69	

the period ending in 1875 to 52 for the 5 years ending in 1885, deviated but slightly from a level of about 45 to 1900, and descended sharply during the succeeding 20 years.

The lethal force of all forms of meningitis rose sharply to its peak in the 5 years ending in 1885, and, declining gradually during the following 15 years, fell conspicuously between 1901 and 1920. During these 20 years acute inflammation of the meninges fell from the position of a principal cause of death to one of comparative insignificance. This decline was due to but small degree to changes in the rate for tuberculous meningitis, which during most of the period held an almost constant level.

Epidemic or meningococcus meningitis was not reported with any regularity until 1917. It will be noted (tables 93 and 94) that in 1916 the deaths exceeded the reported cases in number. Since the fall of 1916 special pressure has been brought to bear to secure early and full case reporting, and isolation of cases and contacts has been imposed. Since this time the diagnosis has de-

pended upon the demonstration of the meningococcus by lumbar puncture during life or at autopsy in fatal cases, and the contacts have been confined or released accordingly as this organism was demonstrated or not in cultures made from the nose and throat. All or nearly all of the cases were treated with antimeningococcus serum and a large proportion of the cases was hospitalized. For the 4-year period, 1917–1920 inclusive, the data at hand as set forth in table 93 may be regarded as exact. During this period the deaths ascribed to simple meningitis (rubric 61) were proven by the use of bacteriological methods to be due to organisms other than the meningococcus. In this 4-year period no secondary cases of meningococcus meningitis were observed among contacts, either in families or institutions. Several cases in 1917 occurred among a detachment of militiamen, recently recruited, and all from the city.

TABLE 94.—*Number of deaths and monthly annual rate of mortality, per 100,000 living inhabitants, from epidemic (meningococcus) meningitis, from 1916 to 1920, inclusive.*

D = death. R = rate.

	1916		1917		1918		1919		1920	
	D	R	D	R	D	R	D	R	D	R
Jan.	2	4	3	6	5	10	4	7	2	3
Feb.	2	4	1	2	5	11	8	14	2	4
Mar.	3	6	5	10	15	29	5	8	6	10
Apr.	...	...	10	20	14	28	4	7	3	5
May	1	2	13	25	11	21	2	3	1	2
June	2	4	10	20	6	12	1	2	3	5
July	2	4	7	13	6	11	3	5	1	2
Aug.	2	4	1	2	5	10	3	5	2	3
Sept.	1	2	1	2	...	...	...	...	2	3
Oct.	...	...	1	2	5	10	3	5	...	...
Nov.	...	...	3	6	1	2	4	7	2	3
Dec.	3	6	3	6	2	4	2	3	1	2
Total	18	3	58	9	75	12	39	5	25	3

The sick and their contacts were at once isolated and the disease failed to extend among the command. Whatever advantages may have been gotten by handling this disease with the same method used in diphtheria have been reaped.

It may be significant that the death-rate was appreciably lower in this outbreak than in that of 1898–1901. However, the favorable showing was perhaps in largest part due to the curative effects of the serum, rather than to isolation methods. The case-fatality rates among the reported cases was 48, 43, 57, and 69 per cent for the respective years. In other words, it is probable that the mortality- rather than the morbidity-rates were favorably affected by the introduction of the new methods. The influence of season upon incidence is striking. In the 4-year period 1917–1920, during which the diagnosis of meningococcus meningitis was established with exactness, the peak of both morbidity and mortality (table 94) occurred in later winter months or spring, February, March, April, or May. In these years there was a recrudescence of the disease in the early summer, and in 1919 this was conspicuous. The disease, like the acute exanthematous diseases, dies down during

the hot months, springs up in the fall, and steadily increases in prevalence during the winter months. The decline from the peak may be gradual or abrupt. In general, the course of the morbidity and mortality curves follow each other closely.

For the 3 years for which data exist for comparing the influence of color and sex upon mortality (table 95) there were no significant differences for color, in fact, the averaged mortality-rates were the same for both whites and negroes. The mortality-rates were distinctly greater in males than in females of both races, and this difference was much more marked in negroes than in whites.

The death-rate from tuberculous meningitis had already made its significant decline before the inauguration of the inadequate reforms in the control of the milk-supply between 1896 and 1918, and during this period it remained practically unchanged. Nor does it appear that on the average the rate was favorably influenced by the other activities of the department of health exercised through nurses and propaganda, for the death-rate from this

TABLE 95.—*Number of deaths and rate of mortality, per 100,000 living inhabitants, from epidemic (meningococcus) meningitis, according to color and sex, from 1918 to 1920, inclusive.*

D = death. R = rate.

Year.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1918	75	12	63	12	34	13	29	11	12	12	10	22	2	4
1919	39	5	35	6	20	7	15	5	4	4	2	4	2	4
1920	25	3	20	3	10	3	10	3	5	5	3	6	2	4

form of tuberculosis was as low between 1900 and 1910 as it was between 1911 and 1918. It is quite possible that the considerable decline in the rate which occurred in 1919 and 1920 was due in part at least to the enforcements of proper pasteurization of milk.

No attempt has ever been made by the health department to erect barriers against the spread of simple meningitis. Restrictive measures were not applied to the spread of epidemic or meningococcus meningitis until 1917, when isolation of cases and carriers was instituted, and anti-meningococcus serum obtained from the New York City Board of Health was furnished freely for treatment of proven cases.

It is clear from the foregoing that from 1875 to 1916 the course of acute meningitis was uninfluenced by any artificial interferences instituted by the health department, and that the curve of mortality reflects during this period the natural history of acute inflammatory affections of the cerebro-spinal meninges on the population. For meningococcus meningitis the facts at hand warrant the inference that from 1917 to 1920 the incidence of the disease may have been diminished by restricted measures and the mortality-rates influenced favorably to some degree by the use of anti-serum freely dispensed.

So much for the picture of the course of meningitis as it may be drawn from the recorded deaths classified under rubrics specifically indicating inflammation of the brain membrane. In regard to repositories for deaths due to inflammation of the meninges before 1872, the statistical nosology contained, both before and after this date, several rubrics under which such deaths must have been allocated. Of these, the most important are inflammation of the brain, dropsy in the head, hydrocephalus, spinal affection, and dropsy of the spine. To the rubric inflammation of the brain, deaths were ascribed each year (with the exception of 1817 and 1902) from 1816 to 1920. With comparatively slight variation from year to year, the number of deaths credited to this rubric increased gradually from 14 in 1818 to 164 in 1853, 221 in 1869, 283 in 1871, and 292 in 1872. The number of deaths declined to 241 in 1873, to 52 in 1875, and to 31 in 1880. Expressed in relative terms, the rate for this rubric rose from 26 in 1818 to 102 in 1872 and, coincidently with the introduction of the rubrics for meningitis, fell abruptly to 17 in 1875 and to 9 in 1880. Between the latter date and 1898, when it stood at 3, the annual rate for inflammation of the brain never rose above 6. As in the light of present knowledge and of the experiences of pathological anatomists, since the middle of the nineteenth century at least, it is inconceivable that the high mortality-rates obtaining for inflammation of the brain before 1875 could have represented inflammatory affections of the substance of this organ, the inference is that the greater moiety, if not most, of the deaths ascribed to this rubric were due to meningitis. Between 1816 and 1874, deaths were assigned to dropsy in the head in each year except 1825, 1826, 1846, and 1847. In occasional years the rubric hydrocephalus also occurred. After 1874, dropsy in the head disappeared and gave place permanently to the rubric hydrocephalus. It is well established that those two terms were used to embrace meningitis of different kinds, that with exudates in both the meninges and the ventricles of the brain, as well as the ordinary congenital hydrocephalus and the various relatively rare types of internal and external hydrocephalus unassociated with acute inflammation developing after birth. Dropsy in the head and hydrocephalus had attained a death-rate of 49 by 1819, and between this date and 1874 the annual rate varied within wide limits, the highest being 90 in 1854 and the lowest 14 in 1863 and 1864. From 58 in 1823, the annual rate had fallen to 18 in 1875 and to 8 in 1882, and since the latter date it has fallen steadily to 2 in 1900, a rate which probably represents the extreme for the congeries of affections now classified under hydrocephalus. There is less certainty in regard to the significance of the rubrics spinal affection and dropsy of the spine, to which there were ascribed a few deaths between 1850 and 1870 and as many as 57 and 58 in 1872 and 1873, respectively, and which disappeared after the rubrics for meningitis were firmly established.

In table 92 are presented the average quinquennial rates from 1816 to 1920 for these various rubrics separately and combined. Under the rubrics dropsy in the head and inflammation of the brain, in so far as they may be taken to represent meningitis, some relatively slight deductions must be made from the first for true hydrocephalus in the present use of the term and from the second for the comparatively rare acute inflammation of the brain substance.

The decline in the rates for dropsy in the head and inflammation of the brain after the introduction of meningitis into the statistical nosology was so marked that the conclusion is forced that previous to 1900 the two former rubrics not only included the latter, but that the combined rates for these rubrics must reflect with some degree of accuracy the course of mortality for meningitis from 1816 to 1900. Viewed in this light, it would appear that during this period meningitis, though subject to several waves of rise and decline in mortality, was continuously a potent cause of death. The period of highest averaged rates was between 1851 and 1880, with the peak (a rate of 145) during the quinquennium 1851–1855. The relatively high rates obtaining up to 1900 were probably due to tuberculous meningitis, meningococcus meningitis, and to the prevalence in virulent form of such diseases as measles, scarlet fever, and wound infections, in which the so-called simple meningitis is apt to occur as a secondary complication. Similarly, the considerable fall

TABLE 96.—*Number of deaths and of reported cases of poliomyelitis and rates of mortality and of morbidity, per 100,000 living inhabitants, for years 1912 to 1920 and 1915 to 1920, respectively, and the percentage of case fatality for the years 1915 to 1920, inclusive.*

Year.	Cases.	Rate.	Deaths.	Rate.	Per cent. case fatality.
1912	...	...	6	1	...
1913	...	...	1	0	...
1914	...	...	2	0	...
1915	26	4	4	1	15
1916	206	34	70	12	34
1917	2	0	0	0	0
1918	38	6	5	1	13
1919	83	12	28	4	34
1920	15	2	4	1	27
Total	370	...	120	...	30

in the total rate for acute diseases of the nervous system since 1880 may be attributed partly to an active decline in the mortality from tuberculous and meningococcus meningitis, partly to decrease in the virulence of the diseases with which simple meningitis is a complication, and partly to gradual increase in the accuracy of classification of deaths to appropriate rubrics.

POLIOMYELITIS.

This disease was first recognized in the statistical nosology in 1912, and since that date it has been credited with one or more deaths in each year except 1917. In the latter year 2 cases were reported. It is certain, therefore, that cases of the disease occurred each year during this 9-year period. In table 96 are given the data for mortality since 1912 and for morbidity and case fatality since 1915. The number of reported cases does not reflect accurately the true incidence of the disease, for some mild and doubtful cases were certainly overlooked. The number of recorded deaths represents actual experience with a fair degree of correctness. The data for the epidemic of 1916 are of unusual

accuracy, for shortly after the beginning of the outbreak all reported cases were seen by trained diagnosticians, and in all fatal cases careful autopsies, with histological examination of the central nervous system, were made by Dr. Mont Burroughs, of the Pathological Laboratory of the Johns Hopkins University and Hospital, or under his direction. In succeeding years all reported cases have been investigated, and autopsies have been held in fatal cases in which the diagnosis was in doubt.

A striking characteristic of poliomyelitis has been the regularity of its rise and decline in wave-like fashion. During the 9 years three such waves stand out clearly. The first began abruptly in 1912 and lasted through 1914. The second wave, starting in 1915 with 26 cases and 4 deaths, reached its peak in 1916 with 206 cases and 70 deaths, and subsided in 1917 with 2 cases and no deaths. The third wave, much less severe than the second, but

TABLE 97.—*Distribution of reported cases and deaths of poliomyelitis, according to months, from 1915 to 1920, inclusive.*

C = cases. D = death.

Month.	1915		1916		1917		1918		1919		1920		Total.	
	C	D	C	D	C	D	C	D	C	D	C	D	C	D
Jan.	...	...	...	...	...	...	...	...	...	...	3	0	3	0
Feb.	...	...	...	...	...	...	...	...	...	...	1	1	1	1
Mar.	...	...	2	2	...	...	1	1	...	...	...	...	3	3
Apr.	...	...	...	...	...	...	...	...	...	...	...	...	0	0
May	...	...	...	...	...	...	...	...	1	1	...	...	1	1
June	1	1	...	...	...	...	8	1	2	1	3	2	14	5
July	11	2	3	1	2	0	11	0	9	2	1	0	37	5
Aug.	13	0	37	16	...	...	7	2	27	10	2	0	86	28
Sept.	1	1	71	24	...	...	8	1	20	8	3	0	103	34
Oct.	...	...	74	21	...	...	3	0	16	5	1	1	94	27
Nov.	...	...	17	4	...	...	...	...	7	1	1	0	25	5
Dec.	...	...	2	2	...	...	...	...	1	0	...	...	3	2
Total	26	4	206	70	2	0	38	5	83	28	15	4	370	111

more serious than the first, began in 1918 with 38 cases and 5 deaths and attained its peak the following year with 83 cases and 28 deaths. With 15 cases and 4 deaths in 1920, this wave had not reached its ebb. It will be noted that, as a rule, case-fatality rate was highest in the years of greatest incidence. It would appear, therefore, that the invasive and the lethal capacities of the disease have varied together.

The monthly distribution of reported cases and deaths for 1915 to 1920 inclusive is given in table 97. The influence of season upon the incidence of the disease is striking. Cases occurred in January, February, and May in but one year each, and in December and March in only two years. No cases occurred in April. On the other hand, cases were reported in June in 4 of 6 years. But 22, or 6 per cent, of a total of 370 cases were reported in the first 5 months of the calendar year. For the remaining months of the year the distribution of reported cases was, in percentages of the total number, July, 10; August, 23; September, 28; October, 25; November, 7; and December, 1. The peak did not

always fall in September, for in the 3 years of greatest incidence it occurred in July, August, or October. A rise in the number of cases in August over July marked a severer season than usual, but even then, as in 1919, this occurrence did not necessarily presage a continued rise during September and October. September, then, is the critical month. The occurrence or non-occurrence of cases in the early months of the year is without significance for predicting a heavy or a light visitation in the succeeding months of a particular year. Nor is the occurrence of cases in the early months necessarily associated with the presence of recognized cases in the city during November and December of the previous year.

With the high average fatality among recognized cases, 30 per cent of the total number reported in the 6 years 1915–1920, it is not surprising that the distribution of deaths by months bears a close relation to that of reported

TABLE 98.—*Influence of age upon incidence and fatality of poliomyelitis in 1916.*

Age-period.	Morbidity.		Mortality		Percentage of case fatality within age groups.
	Number of cases.	Percentage of total cases.	Number of deaths.	Percentage of total deaths.	
0 to 1 year.....	37	17.56	13	16.17	35.14
1 to 2 years....	43	20.98	16	23.53	37.20
2 to 3 years....	53	25.86	16	23.53	30.19
3 to 4 years....	26	12.69	5	7.35	19.23
4 to 5 years....	16	7.80	5	7.35	31.25
5 to 6 years....	9	4.39	3	4.42	33.33
6 to 7 years....	5	2.44	2	2.94	40.00
7 to 8 years....	3	1.46	3	4.42	100.00
8 to 9 years....	3	1.46	2	2.94	66.66
9 to 10 years....	3	1.46	1	1.47	33.33
10 to 15 years....	3	1.46	2	2.94	66.66
15 to 20 years....	3	1.46	1	1.47	33.33
20 to 25 years....	2	0.98	1	1.47	50.00
Total	206	.....	70	.....	33.98

cases. It is worthy of note that the case-fatality rates among the scattered cases of the winter and spring months is higher than among those occurring in the definite outbreaks of the summer and fall months.

On account of the unusual precautions taken to secure exactness of diagnosis, the data in regard to the influence of age, sex, and race upon morbidity and mortality in the outbreak of 1916 are of special importance. The distribution of cases and deaths according to the age of those affected is shown in table 98. Over 77 per cent of the cases and 71 per cent of the deaths occurred in children under 4 years of age. Among these, the incidence was greatest in the third year, while the mortality was heaviest in the second year of life. The fourth year of life was marked by lightness of incidence and fatality. In individuals over the fifth year of age incidence was light, but fatality was uniformly high. While the case fatality for the whole group was 34 per cent, under the fourth year it was 31.44 per cent, and over this age 42.55 per cent. Both morbidity and mortality in negroes were double those in whites and somewhat

greater in males than in females in both races (table 99). The percentage of case-fatality was, however, somewhat lower in negroes than in whites. It was considerably less in females than in males and in white females than in white males. The fatality-rates were identical for the two sexes in negroes.

Restrictive measures on patients and contacts, with hospitalization of a considerable number of cases, were instituted from first appearance of the diseases in 1916, but there is little evidence of a convincing nature that either these measures or the inadequate quarantine attempted on children from New York and other cities where the disease was prevalent interfered seriously with the spread of the affection. At the very height of the outbreak, the incidence of the disease dropped abruptly about the middle of October, immediately after a decided fall in the temperature lasting several days, and subsequent to this, but few cases were reported.

TABLE 99.—*Rate per 100,000 living inhabitants of morbidity and mortality and percentage of case fatality, according to color and sex, for poliomyelitis for 1916.*

	Morbidity.		Mortality.		Percentage case fatality.
	Cases.	Rate.	Deaths.	Rate.	
Total	206	34	70	12	34
Total male	107	36	39	13	36
Total female	99	32	31	10	31
Total white	149	29	51	10	34
White males	80	32	30	12	38
White females ...	69	27	21	8	30
Total colored	57	59	19	20	33
Colored males ...	27	61	9	20	33
Colored females ..	30	57	10	19	33

TETANUS AND ERYSIPELAS.

Tetanus and erysipelas are the only affections associated directly or indirectly with wound infection that can be traced consistently in the mortality tables from the early years of the nineteenth century. Puerperal fever, which will be considered under child-birth, may be followed as a separate entity only since 1875. Through much of the period a considerable number of deaths have been attributed to abcess of various organs. In the seventies, eighties, and early nineties of the last century a significant proportion of deaths (66 in 1889, for instance) was attributed to peritonitis, many of which were doubtless secondary to appendicitis, puerperal infection, and to operations on the abdominal organs. The numerous deaths that must have been caused by septicæmia and pyæmia following wound infection were classified under other headings.

Under the heading lockjaw for the most part until 1850, although in some years classed as tetanus, deaths from this disease were recorded in each year, except 1862, from 1812 to 1920 (table 91). From 1875 to 1898, inclusive, a considerable number of deaths were credited annually to trismus nascentium. Since the disappearance of the latter rubric with the adoption of the inter-

national classification of the causes of death in 1899, deaths from this form of the disease have been classified under tetanus. Previously to 1875, deaths from infantile tetanus were probably classified under convulsions. Judging from the number of deaths attributed to trismus nascentium and to tetanus, respectively (for example, 44 to 11 in 1876; 46 to 16 in 1880; 45 to 12 in 1896), infantile tetanus must have been an important cause of death before 1875. Before the latter date, therefore, the rates calculated from the official figures for tetanus must be far below actual occurrence. The fluctuations in the rates for tetanus from year to year, both before and after 1875, do not in general vary widely. From table 100, in which the rates for tetanus (includ-

TABLE 100.—*Average rate of death, per 100,000 living inhabitants, by 5-year periods, for tetanus and erysipelas, from 1812 to 1920, inclusive.*

Periods.	Tetanus.	Erysipelas.	Periods.	Tetanus.	Erysipelas.	Periods.	Tetanus.	Erysipelas.
1812-15 ...	4	2	1851-55 ...	2	9	1891-95 ...	11	5
1816-20 ...	5	6	1856-60 ...	2	8	1896-1900 .	6	5
1821-25 ...	4	1	1861-65 ...	2	11	1901-05 ...	4	5
1826-30 ...	3	..	1866-70 ...	3	7	1906-10 ...	4	4
1831-35 ...	4	2	1871-75 ...	7	14	1911-15 ...	3	4
1836-40 ...	2	1	1876-80 ...	16	9	1916-20 ...	1	4
1841-45 ...	2	2	1881-85 ...	16	10			
1846-50 ...	3	11	1886-90 ...	13	8			

ing trismus nascentium) as averaged for quinquennial periods are presented, it will be noted that after rising from 4 for the period 1812–1815 to 5 for 1816–1820, the rate fell during the succeeding 10 years, and for the 5 years ending in 1830 was only 3. After rising again to 4 in 1831–1835, the rate declined to 2 during the 10 years 1836–1845. Between 1846 and 1870 the rate fluctuated between 2 and 3. The appearance of trismus nascentium in statistical nosology was reflected by an abrupt rise in the rates to new high levels—7 in 1871–1875, and 16 in 1876–1885. During the next 15 years the rates sharply declined. During the 10 years 1901–1910, the rates stood at 4, between 1911 and 1915 they fell to 3, and during the last 5-year period to 1.

While the spectacular rise in the rates for tetanus after 1875 was due to a very marked degree to changes in the custom of classification of deaths, and the rates before this date must be regarded as much too low, the subsequent course of the curve may be taken as indicating with a fair degree of accuracy the force of mortality from tetanus. There can be no doubt that infantile tetanus was of common occurrence during this period. This question was investigated in the late nineties by Dr. C. Hampson Jones, who found the disease especially common in the practice of midwives. In the practice of one midwife he was able to trace 14 deaths from trismus nascentium. There seems little doubt that the marked fall in the mortality-rate from tetanus since 1895 has been due in large measure to improvement in midwifery, the gradual decrease of Fourth of July accidents from fire-crackers and the like,

the practice of antiseptic and aseptic surgery, and, of late years, the use of prophylactic injections of tetanus antitoxin in connection with wounds suitable for the development of *B. tetani.* Since 1917 tetanus antitoxin has been furnished free of charge to those unable to purchase it for both prophylactic and curative treatment.

With the exception of a few years (1819–1821, 1824–1830, 1836–1837, 1840–1841, and 1844), erysipelas has been credited with deaths in each year from 1814 to 1920, inclusive. The rates, as averaged for quinquennial periods, are given in table 100. It would appear from the official figures that the disease was either not very prevalent, or at least was characterized by a low mortality until after 1845. The number of deaths rose abruptly from 4 in 1845 to 14 in the following year, and it would appear that at this period there began an epidemic wave that lasted until well after 1890. The rate was no higher during the Civil War period than it was between 1846–1850. T. H. Buckler described as unusual occurrences at the city almshouse and infirmary during the latter period a series of very fatal epidemics of this disease. Rising from 2 for the previous quinquennium to 11 between 1846–1850, the averaged rate for erysipelas varied little from this level until after 1865. Falling during the next 5 years to 7, and rebounding to 14 between 1871 and 1875, the rate maintained a level about 9 for 15 years, and held constant at 5 between 1891 and 1905 and at 4 from 1906 to 1920.

Of the various general diseases associated most commonly and most surely with secondary infection with streptococcus, the causal agent of erysipelas, scarlet fever is perhaps the most prominent, and comparison of their course for a possible correlation between their periods of greatest mortality is of some importance. When this is done (tables 34 and 91), it is found that the ascent to high levels in the rate for erysipelas did not begin until 15 years after scarlet fever had attained a high point, that the rate for the latter had fallen from its high level well before that for the former had reached its peak, and that the final decline in the rate for scarlet fever anticipated the fall in the rate for erysipelas. It would appear, therefore, that if comparison of the course of their death-rates indicates anything in this connection, it is that the streptococcus mixed infection in connection with scarlet fever may have been a determining factor in the initial rise in the rate for erysipelas and the subsequent course of that disease. The possible influence of scarlet fever and erysipelas upon the prevalence of puerpural fever will be discussed later.

Although erysipelas has long been a reportable disease, it may not be claimed that attempts at its control by administrative activity of the health department have materially influenced its course. The admission of known cases to general hospitals for treatment had been debarred by fear of its spread long before the practice was forbidden. Oversight of routine cases in homes has not been practiced. Changes in the course of the disease have, then, been due to modification in the infecting agent and its hosts on the one hand and of treatment on the other.

APPENDICITIS.

It is only since 1899 that this cause of death can be traced with any accuracy. Previous to this date, with the exception of a few deaths ascribed to typhilitis after 1881 and to appendicitis after 1895, deaths from this cause

were probably classified chiefly under peritonitis and inflammation of the bowels. The mortality data as annually recorded for typhlitis or appendicitis since 1881 are presented in table 128. It will be observed that from 1890, when interest in this affection appears to have begun, the annual rate rose rather steadily to 10 in 1899. Since this date the annual rate has fluctuated between 10 and 16. But this wide difference in the extremes does not occur as between the first and last years of this period, but rather over short series of years, marking alternate waves of gradual ascent and decline.

When the rates are averaged for 5-year periods, from 1901 to 1920 (table 131) it is found that the average mortality has varied but little, and between the first and the last of these quinquennia there was but a slight increase. It would appear, therefore, that in the mortality from this affection in the period under consideration there is a definite tendency to periodic exacerbations and declines, which, however, are so distributed that over a term of years its lethal force is equalized. As this marks the period in which the diagnosis and surgical treatment and the statistical classification of deaths of this affection have been perfected and stabilized, the recorded mortality-rates may be taken as reflecting the average annual risk in this population of unpreventable death from this cause. In other words, since 1901 the risk of the occurrence of appendicitis in degree of severity beyond the sphere of natural resistance and of remedial agencies has been in the ratio of about 12 in 100,000, or 1 in 8,333, for each inhabitant.

PART VI.—VARIOUS CHRONIC ORGANIC DISEASES.

Chapter XIII.—Tumors.

(Tables 101 to 109, graphs 27 to 29.)

With the exception of 1815 and 1823, deaths from cancer have been recorded every year since 1813, but not until 1875 were they classified by organs affected. In that year deaths from this affection were classified under cancer—diffused, breast, liver, face, rectum, uterus, stomach, neck, leg, brain, and pylorus. In 1878 there were added, cancer of the tongue, testicle, intestines, œsophagus, trachea, mouth, eye, mesentery, arm, omentum, elbow, and spine. Between this date and the adoption of the international system of classification in 1899, the statistical rubrics were expanded to include each organ or part certified in any particular year as the seat of fatal cancer. Since 1905, these have been contracted to conform to the limits of the international system.

Though the rubric tumor appeared in the statistical records in 1821, 1822, 1829, and 1830, it was not until 1833 that it became permanently established. Not until 1875 were the deaths classified by organs affected, i. e., ovary, abdomen, uterus, rectum, and face. As with cancer, the statistical nosology was expanded to include such other organs, but usually only the brain, to which deaths from tumors were ascribed.

That not all deaths due to cancer were properly assigned in the earlier years is clear from the fact that in 1878, to cite one example, there were ascribed to stricture of the rectum 1 death, of the cardiac end of the stomach 6 deaths, and of the intestine 3 deaths. In 1875, 1 death was attributed to tumor of the rectum and another to tumor of the face—very unlikely seats for fatal benign tumors. Since 1910, under the classification rules of the Bureau of the Census, tumor of the brain, which from this date has been recognized with greater frequency than before through the development of operative procedures for its relief, has been hidden under "other diseases of the nervous system." Because a considerable proportion of brain tumors are malignant, this practice has affected the rates for both cancer and tumor. After 1899, deaths ascribed to tumor, with a few relatively unimportant exceptions, have been those thought to have been due to benign tumors of the female generative organs—the ovary and the uterus. Therefore, before this date and particularly in the earlier years, no sharp distinction was drawn between cancer and tumor, and the latter rubric by no means always meant benign tumor, as opposed to cancer. It is likely, however, that the old rubric, cancer, included most tumors now classified under the general heading of cancer and other malignant tumors.

It would serve no useful purpose to trace here the history of the various conceptions of tumors and their classification. It will suffice to point out that, before the beginning of the period under review, it was established that tumors are non-inflammatory or autochthonous new growths, and that benign tumors

cause death mainly by mechanical pressure resulting from position and size, and by such accidents as hemorrhage and torsion, while cancerous or malignant growths tend to spread locally and distantly and, in some ways even yet unknown, to exert, as a rule, specific deleterious effects upon the body as a whole, resulting in anæmia, prostration, and finally death.

In table 101 the data for cancer and tumor are presented separately and combined. It will be noted (graph 27) that the crude mortality-rates for tumors as a whole were relatively low until after 1870. With considerable fluctuations, the annual rates ascended from 2 in 1813 to 15 in 1821 and to 20 in 1846. By 1850 the rate had fallen to 9, and it was not until 1865 that the level of 1846 was again attained. After rising to 27 in 1868 and falling to 20 by 1870, the rate rose steadily, with but few recessions, to 117 in 1920. Through most of the period between 1835 and 1920, the rates for tumor alone show considerable annual fluctuations. Always inconsiderable, the rates exceeded 10 in but one year. These rates rose decidedly between 1865 and 1877, and between the latter year and 1905 there was on the whole but little change. The rates fell appreciably between 1906 and 1915, but from 1916 to 1920 they approached their former higher level.

During the entire period under review, the curve of the rates for cancer alone has followed closely that of the combined rate, and the predominant importance of this rubric has determined the shape of the curve for the combined rate. The rates for cancer, with considerable fluctuations, varied from 2 in 1813 to 11 in 1835. After fluctuating between 5 and 15 from 1835 to 1865, the annual rate reached 20 for the first time in 1867. Having reached 51 in 1880, after several advances and declines, the rate rose, with relatively minor recessions, to 113 in 1920.

When the irregularities due to minor annual fluctuations are smoothed by averaging the rates for 5-year periods (table 102 and graph 28), a sharply cut picture of the course of mortality of these affections is presented. The total rate rose from 4 for the period 1812 to 1815 to 8 for the 5-year period ending in 1820. Following a slight recession during the next 5 years, the rates rose to 9 between 1826 and 1830, and fell to 8 for the period ending in 1835. The rates remained practically stationary at 11 between 1836 and 1845 and at 13 between 1846 and 1860. The slight increase to 16 for the succeeding 5 years was followed by a sharp rise to 23 for the period between 1866 and 1870. From this date, but for a slight recession for the 5 years 1881–1885, the rates rose steadily between 1866 and 1920, and reached 111 for the period 1916–1920. The averaged rates for tumor which never attained 4 before the 5-year period ending in 1870, gradually rose during the next 10 years and averaged 7 between 1876 and 1880. This gain was more than lost during the next 5 years, but after 1885 the course of the rates turned and rose steadily to 8 for the 5 years ending in 1905. Falling during the next 10 years to the level of 1870, for the period between 1911 and 1915, the average rate for the 5 years ending in 1920 was 5. For cancer, the averaged rates were 4 between 1812 and 1815, and 8 during the next 5 years. After receding to 4 between 1821 and 1825, and rising to 9 between 1826 and 1830, the rates remained practically stationary between 1831 and 1850. Rising but slightly to 11 between 1851 and 1860 they ascended more rapidly during the next 15 years to 26 for the period ending in 1875. Between 1876 and 1885 the rates averaged

47, and from 1886 to 1920 the rates rose to 106. It will be noted that after 1895 the rate increased by from 7 to 10 for each 5-year period.

Data are available for calculating the effect of color and sex upon the crude rates for cancer for the 21-year period 1900–1920. These are set forth in table 103. In this period the rates for whites rose from 64 to 116 and for negroes from 55 to 95. For sex, the increases in the rates were: White, males from 46 to 108, females from 81 to 124; negro, males from 23 to 69, females from 81 to 119. The course of the rates for both sexes in whites was much smoother than in negroes. The annual fluctuations in the rates for negro males were particularly marked. There were on the whole no great differences between the rates for females of the two races. In few years, however, do the rates for negro males approach those for white males. In no one of the four groups did the rates fail to increase considerably during the period.

The influence of age upon death-rates for cancer in 1911 and 1920 is shown in table 104. The whole of the mortality below the thirtieth year of life occurred in the white race, in which the rate below the tenth year was 2, between the tenth and nineteenth years only 3, and between the twentieth and twenty-ninth years only 25. Under the tenth year nearly all the deaths occurred in the first year of life, when the rate was 11. The high fatality during the first year of life was doubtless due to congenital tumors, for the most part teratoid. The malignant tumors fatal for the ages 10 to 30 were probably for the most part sarcomata. Following the rates for the whole population from the thirtieth year, it will be noted that they rose from 12 for the third decade to 28 for the fourth, to 114 for the fifth, to 299 for the sixth, to 464 for the seventh, to 603 for the eighth, and to 1,123 for 80 years and over. The rates for the white population were nearly double those for the negro in the third decade, but after this period they conformed closely to those for the whole population during the remainder of the life-span. The rate for the negro, which somewhat exceeded the white and the total rates in the fifth decade, fell somewhat below those in the sixth and seventh decades, and dropping decidedly from 381 to 201 between the seventh and eighth decades, rose to 676 for 80 years and over. From birth to the fortieth year and from the sixtieth year to the end of life, therefore, the rates for whites were decidedly higher than those for negroes.

In comparing the two sexes, all the deaths during the first year were in white females, and all those between the first and the ninth year were in white males. The rates for whites of both sexes under the tenth year were the same. During the second decade, the rate for females failed to rise, while those for males rose continuously to the end of life. The rate for white females crossed that for white males in the third decade and, but for a recession in the eighth decade, remained decidedly higher throughout life. The rates for negro males, which were 11 for the third decade and 13 for the fourth, rose to 71 for the fifth and to 203 for the sixth. Falling to a rate of 152 for the seventh decade, cancer caused no deaths in negro males after the seventieth year of age. Starting with a rate of 17 for the third decade and rising to the level of the rates for white females for the fourth decade, the rate for negro females was 226 in the fifth decade. Again approaching the rate for female whites in the sixth and seventh decades, the negro female rates fell decidedly from 574 in the seventh to 337 in the eighth decade. For

TABLE 101.—*Number of deaths and rate of death, per 100,000 living inhabitants, from cardio-vascular-renal diseases and tumors and the percentages of the respective totals of deaths from all causes, from 1812 to 1920, inclusive.*

D = death. R = rate.

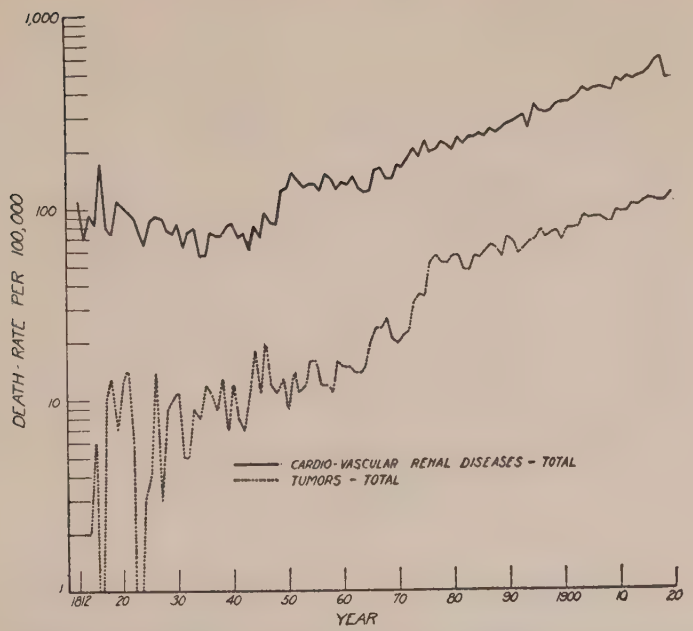
Year.	Cardio-vascular renal diseases.																				Tumors.						
	Diseases of the heart.						Diseases of cerebral blood vessels.						Aneurism and arterio-sclerosis.		Nephritis.		Dropsy.		Total.		Percentage of total deaths from all causes.	Cancer.		Tumor.		Total.		Percentage of total deaths from all causes.
	Angina pectoris.		Organic diseases of the heart.		Total.		Apoplexy,		Softening of the brain.		Total.																
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R		D	R	D	R	D	R	
1812 ..	...	...	....	...	....	...	...	...	...	...	...	...	...	...	....	...	45	110	45	110	4	...	...	...	...	...	...	...
1813 ..	...	...	....	...	....	...	2	5	...	...	2	5	...	...	....	...	28	65	30	70	3	1	2	...	...	1	2	...
1814 ..	...	...	....	...	....	...	6	13	...	...	6	13	...	...	....	...	36	80	42	94	4	1	2	...	...	1	2	...
1815 ..	...	...	....	...	....	...	5	11	...	...	5	11	...	...	....	...	34	73	39	83	3	3	6	...	...	3	6	...
1816 ..	...	...	....	...	....	...	52	107	...	...	52	107	...	...	....	...	33	68	85	174	6	...	...	...	...	...	...	...
1817 ..	...	...	....	...	....	...	5	10	...	...	5	10	...	...	....	...	36	71	41	80	3	5	10	...	...	5	10	...
1818 ..	...	...	....	...	....	...	2	4	...	...	2	4	...	...	....	...	37	70	39	73	2	7	13	...	...	7	13	...
1819 ..	...	...	....	...	....	...	21	38	...	...	21	38	...	...	....	...	41	74	62	112	3	4	7	...	...	4	7	...
1820 ..	...	...	....	...	....	...	18	31	...	...	18	31	...	...	....	...	43	74	61	105	4	7	12	...	...	7	12	...
1821 ..	...	...	....	...	....	...	24	40	...	...	24	40	...	...	....	...	35	58	59	98	3	6	10	3	5	9	15	...
1822 ..	...	...	....	...	....	...	9	14	...	...	9	14	...	...	1	2	47	75	57	91	3	3	5	1	2	4	6	...
1823 ..	...	...	....	...	....	...	12	18	...	...	12	18	...	...	....	...	37	57	49	75	2	...	...	...	...	...	...	...
1824 ..	...	...	2	3	2	3	17	25	...	...	17	25	...	...	....	...	25	37	44	65	3	2	3	...	...	2	3	...
1825 ..	...	...	2	3	2	3	17	24	...	...	17	24	...	...	....	...	44	62	63	89	4	3	4	...	...	3	4	...
1826 ..	...	...	3	4	3	4	3	4	...	...	3	4	...	...	....	...	62	84	68	92	4	10	14	...	...	10	14	...
1827 ..	1	1	3	4	4	5	7	9	...	...	7	9	...	...	....	...	58	76	69	90	5	2	3	...	...	2	3	...
1828 ..	...	...	1	1	1	1	18	23	...	...	18	23	...	...	1	1	43	54	62	78	4	7	9	...	...	7	9	...
1829 ..	...	...	2	2	2	2	13	16	...	...	13	16	...	...	....	...	47	57	62	75	4	7	8	1	1	8	10	...
1830 ..	...	...	1	1	1	1	27	32	...	...	27	32	...	...	....	...	44	51	72	84	4	8	9	1	1	9	11	...
1831 ..	...	...	8	9	8	9	18	20	...	...	18	20	...	...	....	...	30	34	56	63	3	4	5	...	...	4	5	...
1832 ..	...	...	5	5	5	5	26	28	...	...	26	28	...	...	1	1	38	41	70	76	2	5	5	...	...	5	5	...
1833 ..	...	...	7	7	7	7	34	36	...	...	34	36	...	...	....	...	34	36	75	79	3	8	8	1	1	9	9	...
1834 ..	...	...	1	1	1	1	22	22	...	...	22	22	...	...	1	1	32	32	56	57	2	7	7	1	1	8	8	...
1835 ..	...	...	10	10	10	10	21	21	...	...	21	21	...	...	2	2	25	24	58	57	3	11	11	1	1	12	12	...
1836 ..	...	...	6	6	6	6	22	21	...	...	22	21	...	...	1	1	50	47	79	75	4	10	9	2	2	12	11	...
1837 ..	...	...	7	6	7	6	20	18	...	...	20	18	...	...	2	2	50	46	79	72	3	9	8	1	1	10	9	...
1838 ..	...	...	4	4	4	4	25	22	...	...	25	22	...	...	....	...	53	56	92	81	4	11	10	4	4	15	13	...
1839 ..	...	...	5	4	5	4	29	25	...	...	29	25	...	...	2	2	60	51	96	82	4	7	6	1	1	8	7	...
1840 ..	...	...	20	17	20	17	25	21	...	...	25	21	...	...	....	...	57	47	102	84	5	10	8	5	4	15	12	...
1841 ..	...	...	17	14	17	14	22	18	...	...	22	18	...	...	1	1	49	39	89	71	4	9	7	1	1	10	8	...
1842 ..	...	...	27	21	27	21	23	18	...	...	23	18	...	...	2	2	44	34	96	74	4	7	5	2	2	9	7	...

1843	..	...	...	20	15	20	15	20	15	...	...	20	15	...	...	1	1	42	32	83	62	4	12	9	3	2	15	11	...
1844	..	...	...	30	22	30	22	23	17	...	...	23	17	...	...	....	...	58	42	111	81	4	17	12	8	6	25	18	...
1845	..	...	...	39	28	39	28	16	11	...	...	16	11	...	...	1	1	44	31	100	71	3	12	8	3	2	15	11	...
1846	..	...	...	47	32	47	32	31	21	...	...	31	21	...	...	....	...	62	43	140	96	5	20	14	9	6	29	20	...
1847	..	...	...	30	20	30	20	23	15	...	...	23	15	...	...	2	1	72	48	127	85	4	17	11	1	1	18	12	...
1848	..	...	...	29	19	29	19	20	13	...	...	20	13	...	...	2	1	79	51	130	84	3	10	6	7	5	17	11	...
1849	..	...	...	53	33	53	33	34	21	...	...	34	21	...	...	4	3	110	69	201	126	5	20	13	1	1	21	13	...
1850	..	...	...	53	32	53	32	35	21	...	...	35	21	...	...	6	4	118	72	212	129	5	11	7	4	2	15	9	...
1851	..	...	...	83	49	83	49	35	21	...	...	35	21	...	...	3	2	140	83	261	155	6	20	12	3	2	23	14	...
1852	..	...	...	76	44	76	44	47	27	...	...	47	27	...	...	10	6	109	63	242	140	5	13	8	6	3	19	11	...
1853	..	...	...	10	6	10	6	71	40	...	...	71	40	...	...	7	4	146	82	234	131	5	16	9	5	3	21	12	...
1854	..	...	...	69	38	69	38	37	20	...	...	37	20	...	...	2	1	142	78	250	136	5	26	14	4	2	30	16	...
1855	..	...	...	78	41	78	41	36	19	...	...	36	19	...	...	7	4	135	72	256	136	5	27	14	3	2	30	16	...
1856	..	...	...	68	35	68	35	47	24	...	...	47	24	...	...	9	5	117	61	241	125	5	16	8	7	4	23	12	...
1857	..	...	...	99	50	99	50	56	28	...	...	56	28	...	...	11	6	135	68	301	152	6	13	7	10	5	23	12	...
1858	..	...	...	102	50	102	50	55	27	...	...	55	27	...	...	7	3	134	66	298	146	6	19	9	4	2	23	11	...
1859	..	...	...	98	47	98	47	44	21	...	...	44	21	...	...	11	5	113	54	266	127	6	32	15	2	1	34	16	1
1860	..	...	...	89	41	89	41	47	22	...	...	47	22	...	...	11	5	149	69	296	138	6	28	13	5	2	33	15	1
1861	..	...	...	90	41	90	41	44	20	...	...	44	20	...	...	10	5	150	68	294	134	6	30	14	4	2	34	15	1
1862	..	...	...	105	47	105	47	43	19	...	...	43	19	...	...	5	2	181	80	334	148	6	30	13	1	...	31	14	1
1863	..	...	...	103	45	103	45	42	18	...	...	42	18	...	...	5	2	147	64	297	128	5	27	12	5	2	32	14	1
1864	..	...	...	93	39	93	39	37	16	...	...	37	16	...	...	8	3	153	65	291	123	5	32	14	4	2	36	15	1
1865	..	...	...	99	41	99	41	25	10	...	...	25	10	...	...	7	3	174	72	305	126	7	44	18	4	2	48	20	1
1866	..	...	...	120	48	120	48	51	21	...	...	51	21	...	...	7	3	222	89	400	161	7	45	18	14	6	59	24	1
1867	..	...	...	117	46	117	46	43	17	...	...	43	17	...	...	12	5	242	95	414	163	8	51	20	9	4	60	24	1
1868	..	...	...	117	45	117	45	39	15	3	1	42	16	...	...	10	4	211	81	380	146	6	56	22	14	5	70	27	1
1869	..	...	...	121	45	121	45	64	24	1	...	65	24	...	...	25	9	182	68	393	147	6	46	17	11	4	57	21	1
1870	..	...	...	172	63	172	63	73	27	3	1	76	28	...	...	20	7	195	72	463	170	6	47	17	7	3	54	20	1
1871	..	...	...	148	53	148	53	78	28	4	1	82	29	...	...	21	8	208	75	459	165	6	53	19	7	3	60	22	1
1872	..	...	...	171	60	171	60	97	34	2	1	99	35	...	...	34	12	214	75	518	182	6	48	17	18	6	66	23	1
1873	..	...	...	207	71	207	71	95	33	6	2	101	35	...	...	44	15	242	83	594	204	8	78	27	18	6	96	33	1
1874	..	...	...	180	60	180	60	94	32	7	2	101	34	...	...	49	16	225	75	555	186	8	92	31	16	5	108	36	1
1875	..	6	1	261	85	267	88	202	66	40	10	242	79	7	2	75	25	95	31	686	225	9	115	37	33	10	148	49	2
1876	..	9	3	229	74	238	76	194	62	21	7	215	69	2	1	94	30	68	22	617	198	8	141	45	20	6	161	52	2
1877	..	7	2	227	71	234	74	208	65	43	14	251	79	...	...	89	28	81	25	655	206	8	150	47	36	11	186	58	2
1878	..	3	1	319	98	322	99	191	59	37	11	228	70	2	1	92	28	79	24	723	223	11	151	46	19	6	170	52	3
1879	..	13	4	282	85	295	89	173	52	35	11	208	63	5	2	127	38	77	23	712	215	9	152	46	20	6	172	52	2
1880	..	6	2	271	80	277	82	213	63	28	8	241	71	5	1	109	32	52	15	684	202	9	172	51	20	6	193	57	2
1881	..	10	3	351	102	361	104	224	65	31	9	255	74	3	1	134	39	62	18	815	236	9	196	57	1	...	197	57	2
1882	..	16	5	335	95	351	100	180	51	30	9	210	60	6	2	146	41	60	17	773	219	9	163	46	7	2	170	48	2
1883	..	7	2	396	110	403	112	217	60	40	11	257	71	12	3	132	37	57	16	861	239	9	159	44	13	4	172	48	2
1884	..	18	5	369	101	387	105	223	61	37	10	260	71	8	2	173	47	45	12	873	238	11	191	52	19	5	210	57	3
1885	..	16	4	409	109	425	114	227	61	44	12	271	72	8	2	182	49	37	10	923	247	11	185	49	25	7	210	56	3
1886	..	11	3	367	96	378	99	247	65	61	16	308	81	6	2	184	48	39	10	915	240	11	206	54	23	6	229	60	3
1887	..	8	2	414	106	422	108	259	67	57	15	316	81	9	2	226	58	33	8	1006	258	12	239	61	13	3	252	65	3
1888	..	15	4	462	110	477	114	252	60	36	9	288	69	14	3	246	59	25	6	1050	250	12	226	54	36	9	262	62	3
1889	..	26	6	453	106	479	112	287	67	40	9	327	77	8	2	278	65	18	4	1110	260	13	226	53	14	3	240	56	3

TABLE 101.—*Number of deaths and rate of death, per 100,000 living inhabitants, from cardio-vascular-renal diseases and tumors and the percentages of the respective totals of deaths from all causes, from 1812 to 1920, inclusive.*—Continued.

D = death. R = rate.

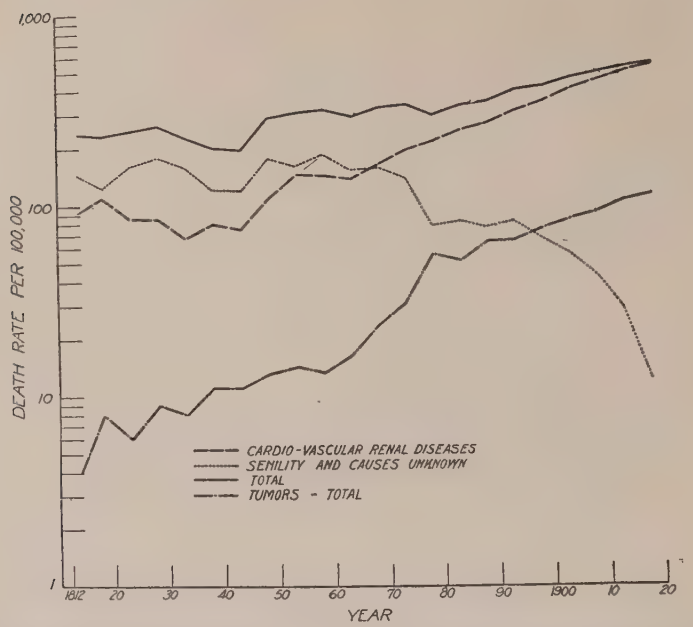
Year.	Cardio-vascular renal diseases.																				Tumors.						
	Diseases of the heart.						Diseases of cerebral blood vessels.						Aneurism and arterio-sclerosis.		Nephritis.		Dropsy.		Total.		Percentage of total deaths from all causes.	Cancer.		Tumor.		Total.		Percentage of total deaths from all causes.
	Angina pectoris.		Organic diseases of the heart.		Total.		Apoplexy.		Softening of the brain.		Total.																
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R		D	R	D	R	D	R	
1890 ..	31	7	462	106	493	113	308	72	42	10	350	82	15	3	303	70	28	6	1189	274	12	276	64	31	7	307	71	3
1891 ..	32	7	492	111	524	119	321	73	28	6	349	79	11	2	331	75	38	9	1253	283	12	267	60	30	7	297	67	3
1892 ..	23	5	515	115	538	120	301	67	34	8	335	75	13	3	406	90	22	5	1314	292	12	233	52	26	6	259	58	2
1893 ..	24	5	494	108	518	113	350	77	38	8	388	85	10	2	450	99	32	7	1398	306	15	251	55	31	7	282	62	3
1894 ..	20	4	525	113	545	117	342	74	27	6	369	80	10	2	266	57	27	6	1217	262	13	286	62	26	6	312	67	3
1895 ..	30	6	552	117	582	123	395	84	42	9	437	93	13	3	559	119	36	8	1627	345	16	302	64	21	4	323	69	3
1896 ..	37	8	561	117	598	125	322	67	26	5	348	73	10	2	541	113	35	7	1532	320	15	332	69	37	8	369	77	4
1897 ..	27	6	548	113	575	118	343	71	25	5	368	76	20	4	546	112	13	3	1522	313	16	316	65	26	5	342	70	4
1898 ..	24	5	578	117	602	122	374	76	...	...	374	76	31	6	550	112	26	5	1583	321	15	331	67	35	7	366	74	4
1899 ..	30	6	552	110	582	116	358	72	31	6	389	78	83	17	668	134	19	4	1741	348	17	339	68	39	8	378	76	4
1900 ..	27	5	613	121	640	126	369	73	42	8	411	81	71	14	656	129	17	3	1795	354	17	318	63	25	5	343	68	3
1901 ..	37	7	597	116	634	123	394	77	29	6	423	82	96	19	650	126	10	2	1813	353	17	358	70	42	8	400	78	4
1902 ..	33	6	683	131	716	138	344	66	40	8	384	74	112	22	695	133	14	3	1921	369	19	384	74	24	5	408	78	4
1903 ..	40	8	717	136	757	144	369	70	22	4	391	74	114	22	751	142	12	2	2025	384	20	370	70	49	9	419	79	4
1904 ..	44	8	771	144	815	153	381	71	24	4	405	76	154	29	824	154	12	2	2210	414	20	450	84	40	7	490	92	5
1905 ..	41	8	794	147	835	154	318	59	29	5	347	64	117	22	853	158	10	2	2162	400	20	437	81	44	8	481	89	5
1906 ..	42	8	839	153	881	161	337	62	20	4	357	65	113	21	909	166	7	1	2267	414	21	450	82	40	7	490	90	5
1907 ..	42	8	852	154	894	161	378	68	15	3	393	71	107	19	933	169	4	1	2331	421	21	473	85	23	4	496	90	4
1908 ..	44	8	829	148	873	156	363	65	13	2	376	67	117	21	945	169	9	2	2320	414	22	449	80	35	6	484	86	5
1909 ..	42	7	834	147	876	155	295	52	21	4	316	56	158	28	929	164	7	1	2286	404	22	450	79	22	4	472	83	5
1910 ..	52	9	978	171	1030	180	390	68	12	2	402	70	176	31	1056	185	...	...	2664	466	25	529	92	30	5	559	98	5
1911 ..	58	10	927	160	985	170	398	69	18	3	416	72	207	36	976	169	...	...	2584	447	25	526	91	28	5	554	96	5
1912 ..	68	12	944	162	1012	173	400	68	7	1	407	70	254	43	1114	191	...	...	2787	477	27	545	93	22	4	567	97	5
1913 ..	59	10	877	149	936	159	530	90	8	1	538	91	182	31	1040	176	...	...	2696	457	27	598	101	22	4	620	105	6
1914 ..	62	10	1005	160	1067	179	509	85	6	1	515	86	311	52	928	156	...	...	2821	473	27	595	100	19	3	614	103	6
1915 ..	45	7	1038	173	1083	180	650	108	5	1	655	109	159	26	998	166	...	...	2895	481	29	627	104	18	3	645	107	6
1916 ..	66	11	1151	190	1217	201	702	116	5	1	707	116	180	30	1013	167	...	...	3117	514	29	636	105	38	6	674	111	6
1917 ..	65	11	1336	218	1401	229	737	120	2	...	739	121	203	33	1129	184	...	...	3472	567	31	640	105	28	5	668	109	6
1918 ..	81	13	1452	235	1533	248	829	134	6	1	835	135	169	27	1148	186	...	...	3685	597	23	637	103	21	3	658	107	4
1919 ..	62	9	1145	159	1207	167	834	116	4	1	838	116	144	20	1137	158	...	...	3326	461	29	749	104	28	4	777	108	7
1920 ..	71	10	1250	170	1321	180	820	112	3	...	823	112	115	16	1091	149	...	...	3350	457	30	827	113	33	5	860	117	8



GRAPH 27 (from table 101). Annual crude mortality rates from tumor (cancer and other tumors) and from cardio-vascular-renal diseases, from 1812 to 1920, inclusive.

TABLE 102.—*Average rate of death, per 100,000 living inhabitants by 5-year periods, from cancer, and other tumors, and from senility and causes unknown in adults, from 1812 to 1920, inclusive.*

Periods.	Cancer.	Tumor.	Total cancer and tumor.	Senility.	Causes unknown.	Total senility and causes unknown.
1812-15	4	...	4	145	...	145
1816-20	8	...	8	123	...	123
1821-25	4	1	5	120	39	159
1826-30	9	...	9	119	56	175
1831-35	7	1	8	126	30	156
1836-40	8	2	10	95	22	117
1841-45	9	3	12	76	40	116
1846-50	10	3	13	96	74	170
1851-55	11	2	13	100	56	156
1856-60	11	3	14	94	73	167
1861-65	14	2	16	85	63	148
1866-70	19	4	23	89	62	151
1871-75	26	6	32	100	36	136
1876-80	47	7	54	72	4	76
1881-85	47	4	51	77	3	80
1886-90	57	6	63	74	1	75
1891-95	59	6	65	80	...	80
1896-1900	66	7	73	65	...	65
1901-05	76	8	84	54	...	54
1906-10	84	5	89	41	...	41
1911-15	97	4	102	28	...	28
1916-20	106	5	111	12	...	12



GRAPH 28 (from tables 102 and 110). Crude mortality rates from tumors (cancer and other tumors), cardio-vascular-renal diseases, and senility and causes unknown in adults, averaged by five-year periods, from 1812 to 1920, inclusive.

TABLE 103.—*Number of deaths and the rate of death, per 100,000 living inhabitants, from cancer, according to color and sex, from 1900 to 1920, inclusive.*

D = death. R = rate.

Year.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1900	318	63	275	64	95	46	180	81	43	55	8	23	35	81
1901	358	70	319	73	118	56	201	90	39	49	7	20	32	73
1902	384	74	340	77	128	60	212	93	44	55	13	36	31	70
1903	370	70	332	74	121	56	211	92	38	47	12	33	26	58
1904	450	84	391	87	147	67	244	105	59	71	18	49	41	90
1905	437	81	380	83	152	68	228	97	57	68	17	45	40	87
1906	450	82	390	84	146	65	244	103	60	71	24	63	36	77
1907	473	85	415	89	168	74	247	103	58	67	13	33	45	95
1908	449	80	386	82	148	64	238	99	63	72	17	43	46	96
1909	450	79	393	82	142	61	251	103	57	64	19	47	38	78
1910	529	92	474	98	176	74	298	121	55	61	12	30	43	88
1911	526	91	469	96	195	82	274	110	57	63	15	36	42	85
1912	545	93	480	98	177	73	303	121	65	71	19	45	46	92
1913	598	101	510	103	198	81	312	124	88	94	33	78	55	108
1914	595	100	515	103	205	83	310	122	80	85	20	47	60	117
1915	627	104	564	111	235	94	329	128	63	66	28	64	35	67
1916	636	105	550	108	261	104	290	112	85	88	25	57	60	114
1917	640	105	568	110	255	100	313	120	72	74	23	51	49	92
1918	637	103	564	109	234	91	330	126	73	74	29	64	44	82
1919	749	104	660	107	286	93	374	121	89	85	27	56	62	110
1920	827	113	724	116	332	108	392	124	103	95	37	69	66	119

80 years and over it rose, however, to 985, as compared with 1,252 for white females. For 1920, the rates followed somewhat different courses. In consequence of the considerable mortality in the first decade and the absence of mortality in the second decade among negroes, the rates for this race and for the total population were higher in the first than in the second 10 years of

TABLE 104.—*Number of deaths and rate of death, per 100,000 living inhabitants, from cancer, according to age, color, and sex, for 1911 and 1920.**

D = death. R = rate.

Age-period.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1911														
Under 1 year....	1	10	1	11	...	....	1	23	...	...	...	...	...	...
Betw. 1 and 2 yrs.	...	....	...	....	...	....	...	....	...	...	...	...	...	...
2 to 4 years....	1	3	1	4	1	7	...	....	...	...	...	...	...	...
5 to 9 years....	...	....	...	....	...	....	...	....	...	...	...	...	...	...
0 to 9 years....	2	2	2	2	1	2	1	2	...	...	...	...	...	...
10 to 19 years....	3	3	3	3	2	5	1	2	...	...	...	...	...	...
20 to 29 years....	14	12	11	25	5	11	6	13	3	15	1	11	2	17
30 to 39 years....	25	28	21	29	7	20	14	37	4	25	1	13	3	37
40 to 49 years....	78	114	61	107	20	73	41	138	17	149	4	71	13	226
50 to 59 years....	135	299	119	305	49	259	70	347	16	264	6	203	10	322
60 to 69 years....	115	464	104	475	40	405	64	532	11	381	2	152	9	574
70 to 79 years....	63	603	61	645	26	660	35	634	2	201	...	...	2	337
80 years and over	30	1123	28	1179	9	1049	19	1252	2	676	...	...	2	985
Total	465	83	410	87	159	69	251	103	55	65	14	36	41	90
1920														
Under 1 year....	1	7	1	8	1	15	...	....	...	...	...	...	...	...
Betw. 1 and 2 yrs. / 2 to 4 years....	3	6	2	4	1	4	1	4	1	16	...	...	1	30
5 to 9 years....	1	2	1	2	1	4	...	....	...	...	...	...	...	...
0 to 9 years....	5	8	4	3	3	5	1	2	1	6	...	...	1	12
10 to 19 years....	5	4	5	5	...	....	5	9	...	...	...	...	...	...
20 to 29 years....	18	12	14	12	8	14	6	10	4	15	2	16	2	15
30 to 39 years....	55	45	43	43	17	34	26	52	12	55	4	36	8	74
40 to 49 years....	151	164	120	156	48	126	72	187	31	199	8	97	23	316
50 to 59 years....	212	339	180	329	86	322	94	335	32	407	11	259	21	581
60 to 69 years....	214	594	198	608	101	660	97	563	16	462	8	467	8	457
70 to 79 years....	140	971	134	1026	63	1126	71	952	6	442	3	496	3	399
80 years and over	27	776	26	832	6	534	20	999	1	282	1	746	...	...
Total	827	113	724	116	332	108	392	124	103	95	37	70	66	119

* The rates for the deaths of 1911 are calculated on the 1910 population figures. Data for deaths from cancer, according to distribution for age, color, and sex, are lacking for 1910.

life. The negro rate surpassed the white rate very considerably from the thirtieth to the sixtieth year, instead of but slightly from the fiftieth to the sixtieth years, as in 1911. In 1920, the rates for whites continued to rise until the eightieth year and then declined, while the negro rates ran on a level between the sixtieth and the eightieth years and declined through the remainder of life. These deviations from the experience of 1911 are found on

further analysis to be due mainly to marked increases in the rates for negro females before the sixtieth year and declines after this period, and to a considerable augmentation in the mortality for negro males throughout life and particularly after the sixtieth year.

From the foregoing account of the relation of recorded deaths from cancer and tumor to the Baltimore population, the following points stand out with clear cut distinctness. As averaged for 5-year periods, the death-rates of these two rubrics taken together increased from 4 for period 1812–1815 to 111 for the 5 years ending in 1920, an increase of 2,650 per cent. This increase was gradual and interrupted until 1860, and abrupt between 1860 and 1880. But for a slight recession between 1881 and 1885 the rates rose continuously to the end of the period. Of the great increase in the rates, 43 per cent occurred in the period previous to 1885. Though before 1910 under the rubric tumor there were doubtless included a not inconsiderable number of deaths due to malignant or cancerous growths, both before and since this date, in comparison with the total mortality, its rate has been almost negligible. Therefore, in analysis of various factors involved in explaining the marked increase in the cancer death-rate, without seriously invalidating results, it may be safely left out of the calculation. Like the death-rates for cancer and tumor combined, those for cancer have shown their greatest proportion of increase since 1885. Since 1900, at least, both the white and the negro race and both sexes have shared in this increase in recorded cancer mortality. In this period the rates for cancer have been higher in females than in males, higher in the aggregate in white than in negro females, higher in white than in negro males. In addition to confirming these results, rates specific for age, calculated for 1911, indicate that under the fortieth and over the fiftieth years of age cancer was considerably more fatal in whites than in negroes.

If these observations may be applied to the whole period under consideration, it is obvious that, other things remaining equal, the cancer death-rate would have been unfavorably influenced by relative increase in the population of whites, especially of women, of females of both races, of whites 40 years and over, and of negroes between the fortieth and the seventieth years.

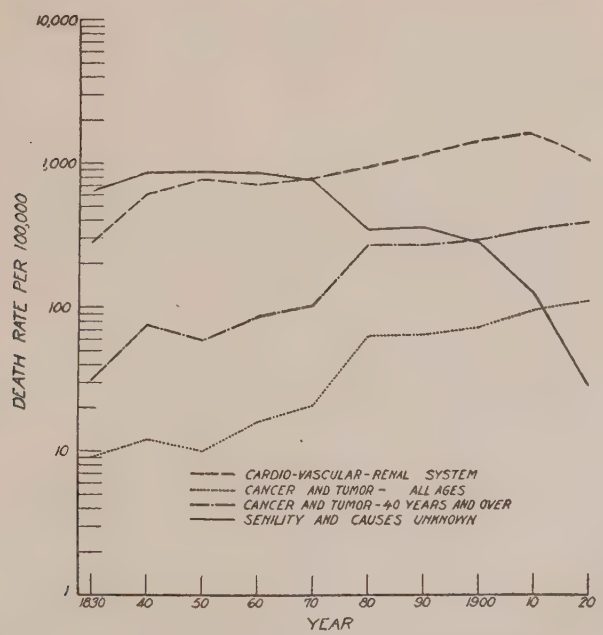
As it has been found that of the deaths ascribed to cancer in 1911 and 1920 only a small proportion occurred in individuals below the fortieth year, and an almost negligible proportion in those under the thirtieth year of age, it is necessary, in reaching an approximately correct estimate of the influence of changes in the age distribution of the population upon the rate of cancer mortality, to disregard the lower age-groups and to consider only those portions of the population above these two ages. Between 1830 and 1920 the percentage of the population 40 years of age and over increased from 15.7 to 28.5 and that 30 years and over from 29.2 to 54.8 of the whole, or by 75 and 55 per cent, respectively. But this notable increase in the proportion of the population in the age-period most susceptible to cancer was, however, in a ratio far below the recorded increase in cancer mortality. Mortality-rates for cancer and tumor for each of the census years between 1830 and 1920, calculated on the basis of the population at all ages and the populations over the twenty-ninth and thirty-ninth years of life, respectively, are given in table 105 and graph 29. Whatever their specific differences, these rates follow the same general course throughout. Each shows an ascent more or less gradual until

TABLE 105.—*Number of deaths and rate of death per 100,000 living inhabitants, of the several age groups, population at all ages, 30 years and over and 40 years and over, from cancer and tumor and from senility and causes unknown in adults, for the census years 1830-1920, inclusive.*

D = death. R = rate.

Census years.	Population, at all ages.						Of 30 years and over.			Of 40 years and over.								
	Cancer.		Tumor.		Cancer and tumor.		Cancer.	Tumor.	Cancer & tumor.	Cancer.	Tumor.	Cancer & tumor.	Senility.		Causes unknown.		Senility and causes unknown.	
	D	R	D	R	D	R	R	R	R	R	R	R	D	R	D	R	D	R
1830	6	7	1	1	7	9	18	3	21	26	4	31	102	450	43	190	145	640
1840	9	9	3	3	12	12	29	10	39	56	19	75	104	651	32	200	136	851
1850	14	8	3	2	17	10	26	6	32	48	10	59	155	535	94	325	249	860
1860	30	14	4	2	34	16	42	6	47	75	10	85	197	492	144	360	341	852
1870	49	18	8	3	57	21	51	8	60	87	14	101	288	513	141	251	429	764
1880	174	52	34	10	208	63	139	27	167	226	44	270	252	327	14	18	266	345
1890	256	59	25	6	281	65	151	15	166	247	24	271	365	352	6	6	371	358
1900	338	67	35	7	373	73	164	17	181	268	28	296	357	283	...	...	357	283
1910	502	90	27	5	529	95	209	11	220	331	18	349	191	126	...	...	191	126
1920	789	108	27	4	816	111	238	8	246	378	13	391	60	29	...	...	60	29

* In each instance the figures for the number of deaths represent the average of three consecutive years, namely, the census year and the year immediately preceding and succeeding.



GRAPH 29 (from tables 105, 110 and 116). Mortality rates from tumor (cancer and other tumors), cardio-vascular-renal diseases, and senility and causes unknown in adults, specific for age-group 40 years of age and over, for the census years 1830 to 1920, inclusive.

1870 and a sharp rise to a much higher level in 1880. It will be noted that between 1880 and 1890 all the rates were stationary. In the 30 years between 1890 and 1920, the rates, however calculated, exhibit progressive and considerable increases. The percentages of these increases in different portions of the period are shown in table 106.

It will be noted that the greater the degree of correction for the age-factor, the smaller the percentage of increase in the rates. It will be recognized that this method fails to account fully for the effect of the age-factor upon the rates for cancer mortality, for here it has been assumed that all increase in the proportional increase in the population above the twenty-ninth and thirty-ninth years of age is of equal consequence in this respect. However, as the risk of dying of cancer increases greatly and in rising ratios from decade to decade of life (table 104) it is evident that increases in the population in the higher decades, the sixth, seventh, and eighth, for instance, must exercise a more marked influence upon the cancer risk than corresponding increases in the fourth and fifth decades. As a matter of fact, in the period 1890–1920

TABLE 106.—*Percentage of increase from one period to another of rates shown in Table 105.*

Periods.	Population of all ages.	Population 30 years and over.	Population 40 years and over.
1890 to 1920.....	71	49	44
1890 to 1900.....	12	9	9
1900 to 1910.....	31	22	15
1910 to 1920.....	17	12	12
1880 to 1890.....	3	..	..

the proportions of the population in the sixth, seventh, and eighth decades of life increased by 21, 26, and 19 per cent, respectively, while the proportional increases in the fourth and fifth decades were only 4 and 16 per cent. So, if it were possible to calculate for each census year rates specific for each of these decades of life, correction for the age-factor would become more striking. When rates for cancer alone specific for age for the census years 1900, 1910, and 1920 are applied to the respective age distribution of a standard population *(Glover's Life Table for the United States)*, a rise in the rate from 105 in 1900 to 173 in 1920, or an increase of 65 per cent, becomes apparent in this 21-year period as due to causes other than age influence.

Among the possible causes other than actual increase in incidence and fatality of cancer, perhaps the most important that may be inquired into are improvement in medical diagnosis and in statistical classification of deaths in the health department. The influence of improvement in diagnosis may be tested somewhat roughly in the following fashion: Deaths recorded as due to cancer since 1875 can be separated with five fairly well-defined groups: (1) breast, (2) female genitals (uterus, ovary, vagina, and pelvis), (3) œsophagus, stomach, and liver, (4) intestines and peritoneum, and (5) all other organs. The first four groups represent respectively rubrics numbers

43, 42, 40, and 41 of the International Classification of Causes of Death, revision of 1909.

Cancer of the breast, equivalent for practical purposes to cancer of the female breast, is not only common enough, but in its fatal stage is easily recognizable. It is the best example of accessible or open cancer of frequent occurrence. It has presented, therefore, little opportunity for errors in diagnosis (in fatal stage) and of classification. Among the important organs not directly on the surface and frequently the seat of fatal cancer, the uterus is the most readily accessible to physical examination. Cancer of this organ can rarely proceed to a fatal termination without giving rise to clinical symptoms and physical signs which would not baffle the diagnostic powers of even a tyro in medicine. Cancer of the ovary and "of the pelvis," the latter appearing only occasionally in the records, is comparatively rare, and is easily recognized at operation. Since 1876, however, but few women in Baltimore with ovarian tumors can have escaped operation. Nor in this period has the diagnosis of the relatively rare primary cancer of the vagina and the external genitals of the female in fatal stages presented any serious difficulty. In cancer of all these organs the important problems have not been concerned with ultimate but rather with early recognition, and with operative technique. Malignant growths of the œsophagus, though not exposed to direct view and relatively uncommon, before the fatal issue give rise to unmistakably characteristic symptoms. While they may be confused with cancer of the cardiac end of the stomach, since both belong to the same rubric, errors of differential diagnosis as between cancer of these two organs are of no present consequence. The diagnosis of cancer of the stomach, even yet often mistaken in fatal cases, has certainly increased very greatly in accuracy since 1875. It was not until well after this date that Dr. Saltzer specialized in diseases of the stomach and introduced the newer methods of gastric analysis, and it was some years before the routine use of chemical and microscopical methods in the diagnosis of diseases of the stomach by Osler in his clinic, opened in 1889, was adopted in other hospitals, and that private clinical laboratories were established. Nor was it before 1900 that through the work of gastro-enterologists, consulting internists, laboratory specialists (including roentgenologists), and surgeons, that the present era of intensive study of diseases of the stomach may be said to have opened in Baltimore. It is evident, therefore, that since 1876 the recognition of gastric cancer in its last as well as in its earlier stages has increased progressively in accuracy. As this organ is one of the most common seats of primary cancer in both sexes, increased precision of diagnosis must have exercised an important rôle in the observed rise in the crude rates for cancer.

While primary cancer of the liver is comparatively rare, of the important viscera this organ is the one which is most frequently the seat of diagnoseable malignant growths originating in other parts of the body. So propitious are conditions in this organ for the deposit and growth of metastases that, from primary cancers in themselves relatively obscure, it is often the seat of secondary growths so prominent on account of their number and size as to fix attention. While a large proportion of cancers of other organs of digestion, as the œsophagus, stomach, intestines, and pancreas metastasize in the liver, it is also often involved secondarily from malignant growths not only of other

abdominal organs, notably the uterus, but of such distant parts as the extremities, the central nervous system, the eye, and the skin. In consequence, though these pecularities of the liver often determine the recognition of cancer that would be otherwise overlooked, likewise they are responsible not unfrequently for errors in statistical classification. With the increase of knowledge of the pathology of cancer and the improvement in diagnosis, doubtless in many instances deaths, which in earlier years would have been credited to cancer of the liver, have in more recent years been assigned in the statistical classification to the proper organs of origin. On the whole, however, it may be assumed that during the last 45 years the diagnosis of malignant growths falling under our third group has undergone a very decided improvement.

The diagnosis of the relatively rare cancer of the small intestines has been until recent years comparatively obscure. The diagnosis and statistical classification of cancer of the colon have without doubt increased greatly in precision, but it is probable that a considerable proportion of deaths from cancer of the small and large intestines (the rectum excepted) are still classified under intestinal obstruction and other rubrics. Cancer of the rectum is comparatively accessible, and it is doubtful if in its terminal stage any marked improvement in its diagnosis has occurred in the period under consideration. Primary cancer of the peritoneum is so infrequent as to be of relatively minor importance.

Cancer of "all other organs" embraces several distinct groups of malignant tumors which vary widely in the ease with which they may be recognized. Cancer of the skin (including the external genitals), the nasal and buccal cavities, the eye, the larynx, the thyroid, the testes, the superficial lymph-glands, the subcutaneous connective tissue, the skeletal muscles, and the bones, which, taken together, represent a very considerable proportion of all malignant growths, have presented, in their fatal stages at least, no great difficulties in diagnosis that have been dissipated by recent advances in medical knowledge. In this respect they are, for the most part, directly comparable with cancer of the breast and uterus. On the other hand, cancer of the lungs and pleura, of the deeper lymphatic system, of the bladder, prostate, and kidneys, of certain abdominal organs, as the pancreas, the kidneys, and the adrenals, and of the central nervous system compose a group numerically less significant than the above and in which diagnosis has in late years achieved very considerable progress. Out of this group, during the last 10 years, fell growths of the brain, many of which are malignant. This error imposed by official rules of statistical classification has been more than counterbalanced, perhaps, by the dispersion to the proper organs of origin the members of the old statistical group "cancer diffused." It seems likely, then, that in a substantial majority of instances the members of the category of "cancer of all other organs" were as readily recognizable in 1876 as in 1920. There can be no doubt that the increased frequency with which autopsies have been conducted by trained pathological anatomists in both homes and hospitals since the opening of the Johns Hopkins Hospital in 1889 has contributed very materially to correctness of diagnosis and in consequence of statistical classification of deaths due to tumors.

All things considered, on the basis of increase in precision of diagnosis alone, there should be no rise in the mortality from cancer of the breast and

uterus, but the advance in the rates for cancer of the œsophagus, stomach, and liver should be considerable; in those for cancer of the intestines and peritoneum very marked; and, finally, the increase in the rates for cancer "of all other organs" should be somewhat less than for cancer of the œsophagus, stomach, and liver. The crude mortality rates for these various categories as averaged for 5-year periods from 1876 to 1920, inclusive, are compared in table 107. It will be observed that though the rate for each has risen, the increases are by no means equal. While the total rate for cancer increased by 125 per cent and the rates for cancer of the breast and of the uterus (and other female organs of generation) rose but by 67 and 42 per cent, respectively, the rate for cancer of the œsophagus, stomach, and liver rose by 160 per cent, and that for the intestines and peritoneum by 550 per cent. On the other hand, the rate for cancer of "all other organs" rose by only 125 per cent, or in the same proportion as the total cancer rate. The increase in the rates for

TABLE 107.—*Rate of death, per 100,000 living inhabitants, by 5-year periods, from cancer, from 1876 to 1920, inclusive.*

Period.	Grand total.	Total rubrics 40 and 41.	Rubric 40.	Rubric 41.	Total rubrics 42 and 43.	Rubric 42.	Rubric 43.	All other organs.
			Stomach, œsophagus and liver.	Intestines, rectum and peritoneum.		Breast.	Uterus ovaries and pelvis.	
1876-80	47	17	15	2	18	6	12	12
1881-85	50	20	16	4	19	7	11	11
1886-90	57	25	20	5	22	8	14	10
1891-95	59	25	21	4	22	8	15	11
1896-1900	66	29	26	4	23	8	16	14
1901-05	76	38	31	8	21	8	13	16
1906-10	84	42	34	8	23	8	15	19
1910-15	98	48	37	11	25	9	15	26
1916-20	106	52	39	13	27	10	17	27

cancer of the breast and of the female generative organs was notably less than it was in those for the other three categories, and the advance in the rates for these latter categories varied roughly with the scope that was assumed to be available for the effect of improvement in diagnosis. But it was assumed that on the basis of improvement in diagnosis the rates for cancer of the breast and of the female generative organs there should be no gain at all. In regard to this point, it is significant that during most of the period, i. e., from 1886 to 1910, these rates were practically stationary. The slight ascents in these rates in the periods before and after these dates may well be explained by variables yet to be considered.

If the mortality for tumors as a whole and for cancer in particular has not actually but only apparently risen in the striking ratio the official figures would seem to indicate, under what statistical rubrics were the unaccounted-for tumor deaths classified? While they may have been dispersed perhaps under many rubrics through which it is now impossible to trace them, two rubrics, causes unknown in adults and senility, probably received the majority.

The rates for these averaged for 5-year periods are compared with those for tumors in table 102. Similar comparisons are made for the census years 1830 to 1920, inclusive, in table 105. The decline in the rates for these indefinite causes much more than counterbalances the ascent in the rates for tumors. Though there is ample room in these rubrics for hidden cancer (as well as for other causes of death improperly assigned), even if the higher rates of later years represented no actual increase in cancer, this evidence is only suggestive. Another heading under which some cancer deaths may well be concealed is intestinal obstruction, but as this is combined in the same rubric with hernia, comparison is not here attempted. Since 1900, and particularly since 1910, special care has been taken in the division of statistics of the health department to secure full and accurate classification of deaths from tumors.

In addition to the direct influence upon cancer mortality-rates, which it has already been pointed out must be attributed to the perfection in the methods of diagnosis and treatment during the last 30 or 40 years, there must be taken into consideration the possibility of an indirect effect. It is a well-established fact that since 1890 an ever-increasing number of individuals with cancer have come to Baltimore from other places for advice and treatment. Some proportion of these must inevitably die here. It is reasonable to suppose, then, that the proportion of cancer deaths in non-residents was low in the early period and high in recent years. Unfortunately, no data on this point are recorded before 1917. However, in the 4 years 1917–1920, inclusive, on an average, 17 per cent of all recorded deaths from malignant tumors were in non-residents—almost all of whom, it is certain, were attracted to the city by the reputation of its physicians and surgeons in diagnosis in general and in the diagnosis and treatment of cancer in particular. It is inconceivable that in early years non-residents could have accounted for anything approaching such a high proportion of the total deaths from cancer. Unhappily, data in regard to deaths of non-residents from benign tumors have not been tabulated, but it is well known that each year an appreciable number of individuals from out of town with growths of this type are operated on by local surgeons and that some fail to survive the experiment. On the other hand, there is no evidence that any significant proportion of residents with either cancer or benign tumor died without the city. Therefore the conclusion is forced that a considerable proportion of the increase in cancer mortality in later years is to be attributed to this factor.

In respect of race, there has been a steady and decided decrease in the percentage of negroes since 1880. The increase of females over males in the general population has hardly been great enough to influence the tumor-rate significantly.

Though some of the increase in the recorded mortality previous to 1870 may well have been due to actual augmentation in the lethal force of tumor, it is unreasonable to suppose that the enormous advance in the rates between 1870 and 1880 can be thus explained. The rates recorded for 1870 would hardly have covered the expected mortality from all tumors readily diagnoseable at that time. Evidently diagnosis and statistical classification of tumors up to this time must have been poor. It is likely, then, that the enormous increase in the tumor-rate for 1880 as compared with 1870 was due

largely, if not entirely, to improvement in statistical classification of deaths inaugurated in 1875 by Commissioner James A. Steuart, who was especially interested in statistics. This view is supported by the facts that there was no increase in the rates for cancer and tumor between 1880 and 1890, and in these 10 years but little progress was made in the precision of diagnosis of cancer of internal organs.

If the foregoing observations and assumptions concerning the influence of age, sex, race, improvements in diagnosis and statistical classification, and the increase in the proportion of non-residents dying of cancer be correct, the course of the rates for tumor (including cancer) can not be considered to signify an actual increase in lethal force in the period up to 1890. If this be true, the bulk of the hidden tumor deaths must have been classified under some other rubric or rubrics for deaths among individuals 40 years of age and over. It has been pointed out already that of these, senility and causes unknown in adults are the most likely rubrics to contain them.

Since between 1880 and 1890 there was practically no increase in the rates for tumors, however calculated, the further course of these affections covers the 30 years since 1890. It has been shown that, since 1900, 35 per cent in the increase in the mortality-rate is explained by changes in the age distribution of the population. Of the remainder, a large part must have been due to advance in precision in medical diagnosis, continued improvement in statistical classification, and the probable augmentation of deaths of non-residents. While they cast considerable doubt upon the question, these considerations do not prove that there has been no real increase in the mortality from tumors (including cancer) in Baltimore. Nor in this discussion has any offset been allowed for any reduction in mortality that should have occurred, if surgeons are correct in their claims of definite cures of cancer of certain organs and of the successful removal of benign tumors of various organs, such as the uterus and ovary, that if left alone must have caused deaths.

There remains yet another test that may be applied to this material, with some hope of getting a clear-cut answer that will cover these objections so far as cancer is concerned. The diagnosis of cancer of the breast and uterus in lethal stages can not be justly held to have improved significantly since 1880. However, since 1890, and particularly since 1900, operative technique for their cure has certainly, as the result primarily of the work of Halsted and Kelly and their associates, been greatly perfected, and of late years many other capable surgeons have adopted like methods. If there has been no actual increase in the mortality from cancer of these two organs, then rates specific for sex and age should show no significant increase between 1880 and 1890, and an actual and not insignificant decrease since the latter date. Rates averaged for 5-year periods from 1876 to 1920, inclusive, for these two categories, in respect of the total female population, that is, rates specific for sex alone, are given in table 108. Since 1880, the percentages of increase in mortality were, for the breast 43, for the uterus 50, and for the two together 47. It is noteworthy that for cancer of the uterus these rates showed a little change between 1895 and 1915; and that those for cancer of the breast were practically stationary from 1880 to 1910. For cancer of the breast since 1910 and for cancer of the uterus since 1915 these rates advanced considerably. As for practical purposes deaths from cancer of the breast and uterus may be

taken as confined to the age-period 40 years and over, and, since 1880, the population figures of this age-group for females is available, it is possible to calculate rates reasonably specific for the actual population exposed to the risk of death from cancer of these organs for the census years 1880 to 1920, inclusive. From these data, presented in table 109, it appears that after 1880 there was no increase in mortality from cancer of the breast, and since 1890

TABLE 108.—*Rate of death, per 100,000 living female inhabitants, by averaged 5-year periods, from cancer of the breast, uterus, ovaries, and pelvis, from 1876 to 1920, inclusive.*

Period.	Total.	Breast.	Uterus, ovaries and pelvis.	Period.	Total.	Breast.	Uterus, ovaries and pelvis.
1876-80	34	12	22	1901-05	40	15	25
1881-85	36	14	22	1906-10	45	16	30
1886-90	42	16	26	1911-15	48	18	30
1891-95	43	15	28	1916-20	53	20	33
1896-1900	44	14	30				

none from cancer of the uterus. On the contrary, since 1910, there has been a notable decrease in mortality from cancer of the breast, and since 1890 from cancer of the uterus and from cancer of these two organs taken together. Thus, when rates that approach specificity are obtained, in respect to cancer of these two organs, in which the disease in fatal stages is readily diagnoseable, an apparent increase in mortality is converted into an actual decrease. Therefore

TABLE 109.—*Number of deaths and the rate of death, per 100,000 living female inhabitants, 40 years of age and over, from cancer of the breast and uterus, for the census years 1880 to 1920, inclusive.*

D = death. R = rate.

Year.	Population.	Total.		Breast.		Uterus.	
		D	R	D	R	D	R
1880	40936	94	230	37	90	57	139
1890	59278	158	286	50	90	108	195
1900	66811	161	241	52	78	109	162
1910	80079	199	249	74	93	125	156
1920	106902	205	192	80	75	125	117

it seems to be established that, during the last 40 years, cancer of the breast and uterus (including the other female organs of generation) has shown no real advance in mortality, and that there is a considerable margin of reduction, especially in respect of the latter category, to be placed probably to the credit of surgical interference.

As the operative mortality for cancer of these two seats is comparatively slight, the question of deaths among non-residents is here relatively of negligible importance.

Since 1890 these specific rates for cancer of the breast and uterus have fallen by 25 and 42 per cent, respectively. As spontaneous recovery from cancer of these organs is unknown, unless the disease has decreased correspondingly in incidence—and for this there is no evidence—these figures may be taken as measuring in a general way the effect upon mortality of earlier diagnosis and improved measures of mechanical treatment. It is not unreasonable to suppose that in the last 20 years at least comparable results have been obtained in cancer of some certain other organs, such as the skin, lip, tongue, bones, and rectum, and that cures have been made at least occasionally of cancers of other organs.

These disclosures in regard to cancer of these two accessible organs indicate very definitely that such proportions of the advances in the crude rates for cancer of all other organs as are not dependent upon changes in the age, sex, and race distribution of the population should be attributed to improvements in diagnosis and statistical classification and to relative increases in the number of deaths of non-residents with cancer coming to the city for diagnosis and treatment and not to an actual increase in mortality. In regard to benign tumors, it will be noted from table 102 that there was but little increase in the crude rates for tumors between 1890 and 1905 and an actual decrease since the latter date. This means that, when corrected for age, the rate for tumor unqualified has declined in the last 30 years and that most of this decline has occurred since 1905. After 1890, at least, most of the deaths ascribed to tumor were associated with benign tumors of the uterus and ovary. It is evident, then, that in this period there has been a fall in the death-rate from tumors of this class. In Baltimore gynæcologists and general surgeons have been operating with success upon such tumors of the ovary since 1870 and of the uterus since 1890. The situation is complicated, however, by the fact that a large proportion of the operations and a considerable proportion of the deaths were in non-residents. On the whole, the decline in the rates for benign tumors may be taken probably as indicative of improved surgical technique. No administrative measures designed to influence the incidence and mortality of cancer have been undertaken.

Chapter XIV.—Diseases of the Cardio-vascular-renal System.

(Tables 101, 110 to 116, graphs 27 to 29.)

Under this general heading will be discussed the course of recorded mortality from certain affections of the heart, blood-vessels, and kidneys. Some of these affections are almost hopelessly mixed, and in many instances it is impossible to decide definitely, even at autopsy, to which one of several categories a particular death should be classified. But slight experience in this field reveals convincing evidence that in many instances the classification of a given death to one rubric instead of to another is determined by the chance that a physician used one term instead of another equally appropriate to define either the primary or the secondary cause of death. This complication has been accentuated in some respects by the classification rules of the Bureau of the Census. It will soon appear that it has not been possible to follow and to include all of the rubrics under diseases of the circulation and of the kidneys. Because diseases of the venous system, thrombosis, and calculi and suppurative affections of the kidneys could not be traced and accounted for in the earlier years, they have been omitted from consideration in later years. Nor is it possible in the available data to study acute and chronic affections separately.

The diseases of the organs under immediate consideration occur in the statistical nosology under a variety of headings, which for convenience are here assembled under the following rubrics: Organic diseases of the heart, apoplexy and softening of the brain, arterio-sclerosis, Bright's disease of the kidneys, and general dropsy. After a brief account of the evolution of these rubrics, the course of the recorded mortality for each will be traced, and then the group as a whole will be considered.

Deaths from affections of the heart appeared in the mortality tables for the first time in 1824 under the heading organic disease of the heart, a statistical rubric which has persisted ever since. With the considerable expansion of the lists of the causes of death after 1875, as refinements of classification there were added numerous other rubrics, such as pericarditis, endocarditis, acute and chronic, mitral and aortic regurgitation, cardiac dropsy, and the like. Angina pectoris, after appearing in 1827, disappeared completely until 1875, and during those 40-odd years deaths from this cause were classified under organic diseases of the heart. Since 1875 deaths have been attributed to angina pectoris in each year. After the adoption of the international list of the causes of death in 1899, deaths attributed to affections of the heart have been distributed among four rubrics—pericarditis, endocarditis, organic disease of the heart, and angina pectoris. It is evident from the foregoing that these rubrics can not be traced consistently before the latter date, and that the old statistical rubric, organic disease of the heart, as used before 1875, embraced all deaths certified as due to disease of any of the various structural

portions of this organ and therefore deaths classifiable under these four modern rubrics. On this account, in any attempt to trace correctly the course of the force of mortality of cardiac affections associated with structural changes, it is necessary to treat these under one generic heading, organic diseases of the heart.

In this connection, for the sake of clearness, it may be pointed out that, as used in contrast to pericarditis, acute endocarditis, and angina pectoris, the rubric *organic disease* of the heart in the international system of classification of causes of death from 1900 to 1920 is absolutely illogical and may lead the unwary into serious error. The adjective organic is here used to indicate disease of structure as opposed to aberrations of function alone. Pericarditis and acute endocarditis, however, convey the concept, disease of organic structure, just as positively and as clearly as do myocarditis and chronic endocarditis, which as certified causes of death are classed with some others under organic diseases of the heart. The rubric under criticism is designed to include deaths from *other* organic diseases of the heart than those which by definition are embraced under the three remaining rubrics. While angina pectoris without structural changes demonstrable by ordinary methods may in exceptional cases be fatal, in the great bulk of cases which have been examined at autopsy by competent pathologists very definite structural changes in the arteries, muscles, or valves of the heart have been demonstrated. In the present section the term organic disease of the heart is used in its broad and proper sense, and the figures presented for each year represent the sum of the deaths recorded under any and all rubrics implying structural changes of the heart, including the pericardium. Angina pectoris is the only one of these rubrics that can be followed separately for any considerable number of years.

Previous to 1899, deaths from apoplexy (including cerebral congestion and hemorrhage) and softening of the brain were recorded in each year, under apoplexy from 1813, congestion of the brain from 1841, and hemorrhage of the brain from 1875. During the years in which these three rubrics occurred together, apoplexy was always credited with the largest number of deaths, and, on the whole, next in importance stood congestion of the brain. In 1899 these three categories were combined in the single rubric, congestion and hemorrhage of the brain and apoplexy, and with the revision of the international classification effective in 1910 this became rubric 64. However, before 1875, the mortality reports carried the rubric hemorrhage without specified organ, to which doubtless some deaths actually due to cerebral hemorrhage were assigned. To the rubric softening of the brain, since its introduction in 1868, deaths have been credited in every year except 1898. In some of the earlier years after its introduction the number of deaths assigned to this rubric amounted to as much as one-third of the number classified under apoplexy, but since 1890 the rubric softening of the brain has steadily declined in relative importance.

In this section the deaths classified under congestion and hemorrhage of the brain and apoplexy have been placed under a single rubric corresponding to the present rubric 64 of the international classification, and thus for convenience will be called apoplexy. There can be no doubt that the two rubrics of the statistical nosology, apoplexy and softening of the brain, have been used throughout the whole period for deaths due to affections falling under the same

clinical and anatomical categories, namely, loss of consciousness with paralysis, caused in the vast majority of instances by lesions of the cerebral blood-vessels. For present purposes it is unimportant, whether the resulting injury to the brain be brought about directly by anæmia due to closure of blood-vessels from thrombosis, embolism, sclerosis, or by spasmodic contraction of the cerebral vessels, resulting or not in necrosis (with softening) of brain tissue, or by pressure (and anæmia) cause by œdema or by actual vascular rupture with hemorrhage. As a matter of fact, in many instances, differential diagnosis can be made with certainty only at autopsy. In any case, the injury to the brain is almost always secondary to lesions primarily vascular, and in the great majority of cases associated with hemorrhage into the brain-tissue. In a certain proportion of instances apoplexy is caused by the plugging of one or more cerebral vessels by emboli from the heart, usually associated with acute endocarditis, and in recent times a large moiety of deaths so caused have been assigned under the rules to the primary cardiac disease.

No direct recognition of arterial disease appeared in the mortality tables until 1875, when 7 deaths were classified under aneurism. In each succeeding year until 1899, with one exception, a few deaths were assigned to this rubric. The highest number in any one year was 20 in 1897. In 1898, to the new rubrics, atheroma and arterial sclerosis, a few deaths were credited. In 1899, these three rubrics were combined in the single rubric, diseases of the arteries, which has since grown steadily in importance.

The earliest mention of renal affections in the mortality records was in 1822, when 1 death was recorded from nephritis, a term which did not appear again until 1847. Inflammation of the kidneys, credited with 1 death in 1828, and with from 1 to 2 deaths in 9 of the following 19 years, appeared in the statistical nosology each year between 1854 and 1897. For most of this period this was the chief rubric under which deaths from renal disease were recorded. To albuminuria, which appeared first in 1875, a few deaths were attributed nearly every subsequent year until 1899. The rubric Bright's disease, introduced for the first time in 1872, gradually increased relatively in importance and after 1898 completely superseded the other rubrics and became the sole statistical repository for deaths from non-suppurative diseases of the kidneys. In a few years before 1899, 1 or 2 deaths were attributed to renal calculi or to renal abcess. Not until 1899 was a clear-cut attempt made to distinguish between deaths due to Bright's disease in the ordinary medical meaning of the term and those due to affections of the kidneys associated with calculi and with primary and secondary tuberculosis and suppuration of these organs. However, since these affections are relatively rare as compared with Bright's disease, for the present discussion they may be disregarded. Since 1900 acute and chronic Bright's disease have been classified separately.

The rubric dropsy or general dropsy appeared continuously in the mortality tables from 1812 to very recent years. As illustrative of its importance in the statistical nosology in earlier times, in typical years the number of deaths assigned to this rubric were 58 in 1827, 57 in 1840, 118 in 1850, 149 in 1860, 195 in 1870. In some years these figures were greatly exceeded. Between 1875 and 1898 this rubric was split into general, cardiac, renal, and abdominal dropsy. After 1875, with the rapid and continuous expansion of rubrics for heart disease, general dropsy steadily decreased in importance, and

by 1910 had become insignificant. In the compilation of the tables for this section, deaths from cardiac and renal dropsy have been assigned to heart and renal diseases, respectively, and deaths from abdominal dropsy to cirrhosis of the liver. Under dropsy have been tabulated only deaths classified as due to dropsy unqualified and to general dropsy.

With the foregoing explanation of the sources and the order of the data at hand, consideration of the course of mortality under the several rubrics will be undertaken. The number of officially recorded deaths each year between

TABLE 110.—*Average rate of death, per 100,000 living inhabitants, by 5-year periods, from diseases of the cardio-vascular-renal system, senility, causes unknown (adult), and tumors, from 1812 to 1920, inclusive.*

Periods.	Cardio-vascular-renal system.							Senility and causes unknown.			Grand total cardio-vascular-renal system, senility and causes unknown.	Total tumors.
	Diseases of the heart.	Dropsy.	Aneurysm and arterio-sclerosis.	Nephritis.	Total, excluding apoplexy and softening of the brain.	Apoplexy and softening of the brain.	Total.	Senility.	Causes unknown (adult).	Total.		
1812-15	....	82	....	....	82	10	92	145	....	145	237	4
1816-20	....	71	....	....	71	38	109	123	....	123	232	8
1821-25	3	58	....	....	61	24	85	120	39	159	244	6
1826-30	3	64	....	....	67	17	84	119	56	175	259	9
1831-35	7	33	....	1	41	25	66	126	30	156	222	8
1836-40	7	49	....	1	57	21	78	95	22	117	195	11
1841-45	20	36	....	1	57	16	73	76	40	116	189	11
1846-50	27	57	....	2	86	18	104	96	74	170	274	13
1851-55	36	75	....	3	114	25	139	100	56	156	295	14
1856-60	45	64	....	5	114	24	138	94	73	167	305	13
1861-65	42	70	....	3	115	17	132	85	63	148	280	16
1866-70	50	81	....	6	137	21	158	89	62	151	309	23
1871-75	62	68	....	15	145	42	187	100	36	136	323	30
1876-80	84	22	1	31	138	70	208	72	4	76	284	54
1881-85	107	15	2	43	167	70	237	77	3	80	317	50
1886-90	109	7	3	60	179	78	257	74	1	75	332	63
1891-95	119	7	3	88	217	82	299	80	....	80	379	64
1896-1900	122	4	9	120	255	77	332	65	....	65	397	73
1901-05	142	2	22	143	309	74	383	54	....	54	437	83
1906-10	163	1	24	170	358	66	424	41	....	41	465	89
1911-15	172	....	38	171	381	86	467	28	....	28	495	102
1916-20	194	....	25	169	388	120	508	12	....	12	520	110

1824 and 1920 from organic disease of the heart as above defined and the mortality-rates calculated therefrom are given in table 101. With rather wide fluctuations from year to year the mortality-rates rose from 3 in 1824 to 10 in 1835, 17 in 1840, 32 in 1846, 49 in 1851, and 63 in 1870. With considerable annual variations, the rates rose gradually during the next three decades to 126 in 1900. From this date there was an almost uninterrupted ascent in the rates to 248 in 1918, with an abrupt fall to 167 in 1919, succeeded by a rise to 180 in 1920.

The annual rates averaged for quinquennial periods (table 110) show no significant rise between 1821 and 1840. Except for a slight setback for the

period 1861–1865, there was a steady ascent in the averaged rates from 20 for the quinquennium 1841–1845, to 62 for that ending in 1875. The rate of increase was considerably accelerated during the next 10 years, but there was no significant advance during the quinquennium 1886–1890. From 109 for the latter period, the rates advanced to 119 for 1891–1895, and after again remaining almost stationary for the succeeding 5 years, they jumped steadily upwards after 1901, and for the period ending in 1920 stood at 194.

The influence of age upon mortality from organic diseases of the heart in 1920 upon the whole population and upon whites and negroes taken separately is shown in table 111. The data used include deaths recorded officially under pericarditis, endocarditis, organic disease of the heart, and angina pectoris, but not those under congenital malformation. For the whole population

TABLE 111.—*Number of deaths and rate of death, per 100,000 living inhabitants, from organic diseases of the heart, according to age, color, and sex, for 1920.*

D = death. R = rate.

Age-period.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
Under 1 year.....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
1 to 4 years.....	3	6	1	2	...	....	1	4	2	31	1	32	1	30
5 to 9 years.....	11	17	10	18	4	14	6	22	1	12	1	26	...	....
0 to 9 years.....	14	10	11	9	4	7	7	12	3	18	2	25	1	12
10 to 19 years.....	42	34	31	29	20	38	11	20	11	69	4	57	7	79
20 to 29 years.....	60	41	37	31	18	31	19	32	23	89	13	107	10	73
30 to 39 years.....	98	80	61	61	30	59	31	62	37	170	25	226	12	111
40 to 49 years.....	168	182	97	126	51	134	46	119	71	456	42	507	29	398
50 to 59 years.....	253	404	178	325	108	405	70	250	75	954	35	825	40	1107
60 to 69 years.....	276	767	224	688	113	738	111	644	52	1501	25	1459	27	541
70 to 79 years.....	292	2026	268	2052	117	2090	151	2024	24	1770	13	2149	11	1465
80 years and over.	163	4684	154	4926	49	4363	105	5242	9	2542	2	1493	7	3182
Total	1366	186	1061	170	510	165	551	174	305	282	161	302	144	260

by decennial periods the rates were 10 for the first, 34 for the second, 41 for the third, 80 for the fourth, 182 for the fifth, 404 for the sixth, 767 for the seventh, 2,026 for the eighth, and 4,684 for the eightieth year and over. The mortality, but slight before the thirtieth year, increases progressively from this period into old age. For every age-group below the seventieth year, the force of mortality is higher in negroes than in whites and for every decade of life from the first to the seventh, inclusive, the mortality-rate for the former is more than double that for the latter. From the thirtieth year in whites and from the twentieth in negroes the rates increase sharply and progressively with advancing years. In the white race the mortality in females is considerably higher than that for males in the first decade of life, with rates of 12 and 7, respectively. This condition is reversed in the second decade, but between the twentieth and thirty-ninth years the rates for the two sexes are almost identical. Beween the fortieth and the seventy-ninth years the mortality-rates are decidedly higher in males, but from the eightieth year the

advantage is with the latter. Among negroes, below the tenth year the rate for males is double that for females. In the second, sixth, and seventh decades and over 80 years the chances of dying of cardiac disease is considerably less for males than for females, but in the remaining decades the advantage is with the females. For this particular year the rates for all ages for these separate categories were: Whole population, 186; total whites, 169; white males, 165; white females, 174; total negroes, 282; negro males, 302; negro females, 260. Thus, the rates were considerably higher in negroes than in whites, and somewhat higher in white females than in white males and in negro males than in negro females.

It is evident that variations in the proportion of the population over 30 years of age and in the ratios of whites to negroes and of males to females must have very materially influenced the course of the mortality from cardiac disease. Changes in the age distribution of the population can not have exerted any marked influence upon the recorded mortality-rates since 1830, for, when these rates are corrected for this factor, it appears that not more than 5 per cent of the advance can be so explained.

In table 101 the course of the annual mortality-rates for the rubrics apoplexy and softening of the brain may be followed. Studying the combined rates, and omitting from consideration the figures for 1816 (which are given under the heading apoplexy) as subject to large error, it will be observed that the rate rose with some fluctuations from the very low level of 5 in 1813 to 40 by 1821. During the next 30 years the rate varied from 4 in 1826 to 36 in 1833, and in 1845 stood at 11. Between 1846 and 1874 there was no considerable rise in the rates, but the annual variation became less marked. As the rates jumped from 34 in 1874 to 79 in 1875, and as after this date never but once (1909) fell below 60, it would appear that the rates were affected considerably by the introduction of death certificates in the latter year. With exceptionally high rates in only a few years (85 in 1893, 93 in 1895, 91 in 1913, and 86 in 1914), there was remarkably little change in the rates between 1875 and 1915. Rising abruptly to 109 in 1915, the rate reached the unusually high level of 135 by 1918, to fall to 112 by 1920.

Passing now to rates averaged for 5-year periods (table 110), it will be noted that the rate, after rising abruptly from 10 for 1812–1815 to 38 for 1816–1820, fluctuated between 16 as the lowest and 42 as the highest for any quinquennial period until 1875. The course of the rates during these 60 years is marked by instability. Having risen to 70 for the 5 years 1876–1880, and retained this level for the succeeding quinquennium, the rates rose to 78 between 1886 and 1890, and to 82 between 1891 and 1895. During the next 15 years there was a gradual recession, and for the quinquennium 1906–1910, the rate stood at 66. During the period 1911–1915, though there was an upward turn to 86, the rate was not markedly above the highest previous level. The rise during the next quinquennium to 120, due largely but by no means entirely to the excessively high rates of 135 in 1918, the year of the great influenza epidemic, showed not only a marked increase over the period immediately preceding, but well nigh a doubling in the rate within 10 years.

As measured by the experience of 1920 (table 112), the mortality-rates for this rubric were decidedly higher for negroes than for whites, and for males than for females in both races. The influence of age is conspicuous. The rates

are negligible below the thirtieth year both in whites and in negroes, and relatively insignificant in whites until the fifth decade of life. Among the whites the greater mortality in females over males occurs in all the age distributions below the sixtieth year, and after this age the advantage is slightly with the female, except between 70 and 80. Among negroes the mortality is markedly higher in females than in males for each age-group below the eightieth year. Not until extreme old age—80 years and over—do the rates for negroes fall below those for whites.

The rates for renal disease, exclusive of tumors and as previously qualified, averaged for 5-year periods, are given in table 110. It is evident that until 1890, at least, these rates measure rather the degree of the recognition than

TABLE 112.—*Number of deaths and rate of death, per 100,000 living inhabitants, from apoplexy, according to age, color, and sex, for 1920.**

D = death. R = rate.

Age-period.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
Under 1 year	...	....	...	....	...	....	...	....	...	....	...	....	...	....
1 to 4 years	...	....	...	....	...	....	...	....	...	....	...	....	...	....
5 to 9 years	...	....	...	....	...	....	...	....	...	....	...	....	...	....
0 to 9 years	...	....	...	....	...	....	...	....	...	....	...	....	...	....
10 to 19 years	1	1	...	....	...	....	...	....	1	6	...	....	1	11
20 to 29 years	3	2	3	3	3	5	...	....	...	....	...	....	...	....
30 to 39 years	25	20	11	11	4	8	7	14	14	64	5	45	9	84
40 to 49 years	75	81	38	50	18	47	20	52	37	238	15	181	22	302
50 to 59 years	156	249	106	194	49	184	57	203	50	636	20	471	30	830
60 to 69 years	244	678	201	618	104	679	97	563	43	1244	17	992	26	1484
70 to 79 years	224	1554	205	1570	88	1572	117	1568	19	1401	6	992	13	1731
80 years and over	92	2644	83	2655	30	2671	53	2646	9	2542	4	2985	5	2273
Total	820	112	647	104	296	96	351	111	173	159	67	126	106	191

* This distribution of deaths does not include the 3 recorded under softening of the brain for this year.

the lethal force of kidney affections. Not until after 1855 did the rate for kidney disease as a whole equal the rate of 5 in 1920 for renal affections other than Bright's disease, and as late as 1871–1875 the rate was only 15. By a steady rise the rate increased by 300 per cent during the succeeding 15 years and for the period 1886–1890 was 60. Having advanced from 88 for 1891–1895 to 143 for 1901–1905, during the next 15 years the average rate for Bright's disease scarcely varied from 170. Since 1901, deaths from acute and chronic nephritis have been recorded separately. From the averaged rates for these two rubrics, it appears that for the first 2 and the last of the 4 quinquennial period the rates for acute Bright's disease did not vary far from 12, while for the third period they were double this figure. The fluctuations in the rates for chronic nephritis since 1905 have been comparatively slight. Using the data for 1920 for comparison (table 113), it appears that while the rate was about one-half higher in the negro than the white population, there

was no considerable difference in the mortality for the two sexes of either race. The influence of age, however, was very marked. For the whole population mortality rates were negligible in the first decade and in the second decade the rates for each category were uniformly relatively low. From the twentieth to the eightieth year the rate for each decade of life was more than double that for the age-period immediately preceding, the actual increase being from 25 in the third to 1,741 in the eighth decade. In the age-group 80 and over the mortality was 2,874. While this same ratio of increase obtained for whites, the progress of mortality through the decades of life was somewhat different for negroes, among whom it was not maintained during the seventh and eighth decades. In whites, as between the sexes, the rates were uniformly higher in

TABLE 113.—*Number of deaths and rate of death, per 100,000 living inhabitants, from nephritis, according to age, color, and sex, for 1920.*

D = death. R = rate.

Age-period.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
Under 1 year.....	2	13	1	8	1	15	...	....	1	51	...	....	1	99
1 to 4 years.....	1	2	1	2	...	....	1	4	...	....	...	....	...	....
5 to 9 years.....	1	2	1	2	1	4	...	....	...	....	...	....	...	....
0 to 9 years.....	4	3	3	3	2	3	1	2	1	6	...	....	1	12
10 to 19 years.....	12	10	11	9	6	11	5	9	1	6	...	....	1	11
20 to 29 years.....	36	25	22	18	11	19	11	18	14	54	10	82	4	29
30 to 39 years.....	67	55	44	44	28	56	16	32	23	105	12	109	11	102
40 to 49 years.....	127	138	81	106	37	97	44	114	46	295	17	205	29	398
50 to 59 years.....	225	360	162	296	90	337	72	257	63	802	34	801	29	803
60 to 69 years.....	269	747	223	685	123	804	100	580	46	1331	21	1226	25	1427
70 to 79 years.....	251	1741	226	1731	110	1965	116	1555	25	1844	14	2314	11	1465
80 years and over..	100	2874	89	2847	41	3651	48	2396	11	3107	4	2935	7	3182
Total	1091	149	861	138	448	145	413	130	230	212	112	210	118	213

males than in females, except in the fifth decade of life. In negroes, the rates for males were higher than those for females only in the fifth, sixth, and seventh decades and in the age-group 80 years and over. On the whole, the variations in mortality between the sexes in respect of the different age-groups were less marked in the black than in the white race.

With average rates not over 3 for the 4 quinquennial periods between 1876 and 1895, the mortality ascribed to arterial disease (table 110) reached 9 between 1896 and 1900, and 22 between 1901 and 1905. Rising slightly to 24 for the next 5-year period, the rates advanced to 38 between 1911 and 1915 and fell to 25 between 1916 and 1920. Using the year 1920 as a criterion (table 114), it is observed that while the rates were nearly twice as great in whites as in negroes, there was little or no difference in the rates for the two sexes of these races. In regard to age, no deaths were recorded in whites below the fortieth year, and the mortality was slight below the sixtieth year. In negroes, on the other hand, there were no deaths before the sixtieth year of age. The rates were higher for females than for males only in the eighth

decade of life among whites. Higher rates for males than for females occurred among negroes in the seventh decade and after the eightieth year. The comparatively low death-rate for the whole population, and the occurrence of recorded deaths only in the high age-ranges, suggest that deaths certified as due to arterio-sclerosis in Baltimore were associated chiefly with the senile type of the disease. It is well established among pathological anatomists that diffuse or general arterio-sclerosis of the Gull and Sutton type is common, especially among white and negro males between the forty-fifth and the sixtieth years.

The mortality-rates from general dropsy (table 110) followed an entirely different course from those for the other rubrics under consideration. Though there were occasional fluctuations, the course of mortality between 1812–1815 and 1916–1920 was generally downward. Rates over 60 were attained in 8 quinquennial periods, in 2 of which the rates were over 80. The decline

TABLE 114.—*Number of deaths and rate of death, per 100,000 living inhabitants, from arterio-sclerosis, according to age, color, and sex, for 1920.*

D = death. R = rate.

Age-period.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1 to 39 years.....	...	....	...	....	...	....	...	...	...	...	...	...	...	...
40 to 49 years.....	2	2	2	3	1	3	1	3	...	...	...	...	...	...
50 to 59 years.....	5	8	5	9	3	11	2	7	...	...	...	...	...	...
60 to 69 years.....	29	81	24	74	16	105	8	46	5	144	3	175	2	114
70 to 79 years.....	40	278	37	283	10	179	27	362	3	221	1	165	2	266
80 years and over.	39	1121	37	1184	19	1692	18	899	2	565	1	746	1	455
Total	115	16	105	17	49	16	56	18	10	9	5	9	5	9

after 1876, during the period in which the increase for the other rubrics was greatest, is very striking.

In the period under review the mortality-rates from three of these rubrics, heart disease, nephritis, and arterial disease (arterio-sclerosis and apoplexy), have increased. The rate of increase, while not steady and unbroken for any one, has been great—in the case of the heart disease by over 6,000 per cent. The mortality-rate for dropsy, on the other hand, has undergone a decrease, which since 1870 has been notable. In how far are these changes real and dependent upon actual modifications in the lethal force of diseases of these organs? To what degree are they apparent and to be explained by advancement in medical knowledge, especially in pathology and in methods of precision in diagnosis, and by changes in classification of causes of death? It is impossible to answer these questions with exactness, but several lines of inquiry offer promise of partial explanations.

Owing to the definite objective character of the clinical symptoms in average cases and early knowledge of its pathology, apoplexy was the first of these causes of death in which diagnosis may be expected to have been made with

comparative readiness and certainty. The classification of deaths from typical apoplectic stroke was never in this period subject to confusion. While it is quite possible that some deaths properly belonging under this rubric may have been classified under paralysis, the course of recorded mortality from that cause (table 117) does not suggest that this was done in any large proportion of instances. More likely, some deaths in the aged following remotely upon apoplexy may have been classified under senility or under causes unknown. The evidence at hand suggests very strongly that the trend of the recorded data concerning apoplexy reflects with a moderate degree of accuracy the actual course of the lethal force of the diseases of the cerebral vessels upon which the clinical picture of this affection is founded.

While the importance of aneurism and of sclerosis, or atheroma as it was commonly called, of the arteries of certain organs, those of the heart and brain in particular, and the frequent occurrence of pipestem-like thickening with calcification of superficial arteries in the aged had long been recognized, it was not until after the work of Gull and Sutton in 1872 that general arterio-sclerosis gained admission to medical nosology. Its importance as one of the most, or indeed the most, common and serious disease of the vascular system was first called to the attention of the local medical profession in 1890 by Osler, who recognized it clinically, and by Welch, Councilman, and the writer, who studied it at autopsy. Ten years elapsed before these teachings were seriously reflected in the mortality-rate for arterial disease. Owing to the fact that so many of the objective and subjective symptoms of the disease center about the heart, which in so many cases breaks down under its burden, many of the deaths of individuals in whom arterio-sclerosis is the primary affection are returned as due to primary disease of the heart. This was especially the case when heart hypertrophy, of which arterio-sclerosis is the most common cause after the fortieth or fiftieth year, was regarded as a primary disease rather than a compensatory adaptation. On account of the renal disease which usually but not necessarily attends arterio-sclerosis, a not inconsiderable proportion of deaths that should be ascribed to the latter are yet credited by physicians to the former disease. As the great mass of instances of cerebral hemorrhage or apoplexy and of angina pectoris are due to arterio-sclerosis, and as many deaths from general arterio-sclerosis have been certified and classified under cardiac and renal disease, it is clear that the official figures for arterio-sclerosis fall far short of actual occurrence. The mortality from general arterio-sclerosis, whatever it was before 1900, was probably hidden partly in renal but chiefly in cardiac diseases. This affection in typical form was very common in 1890, when it was first recognized in Baltimore. All the evidence at hand supports the opinion that it was by no means a new disease, but only a common disease newly recognized. It would appear that there has been no significant change in the rate of its recognition since 1900. It has been pointed out in the discussion of the age distribution of deaths classified under arterial disease that deaths certified as due to arterio-sclerosis by physicians must be confined largely to the senile type.

Until 1895, the mortality figures measure the degree of recognition rather than the lethal force of kidney disease, for even allowing for differences in the age distribution of the population, unless the mortality increased in ratios that stagger the imagination, the picture presented by these figures can not

truly represent actual occurrence. The mortality-rates for renal disease did not reach 15 until the quinquennium 1871–1875, half a century after Richard Bright's first contributions to the pathology of the kidney affections identified with his name and a quarter of a century after Charles Frick had impressed upon his Baltimore colleagues the importance of the use of chemical methods, and when Christopher Johnson, sr., was using microscopical methods of urinary examination. By 1890 there could have been few physicians unfamiliar with the clinical course of Bright's disease, but, nevertheless, within the next 10 years the mortality-rate doubled, and continued to rise until 1906. It may well be that the failure of the rate for nephritis to rise between 1906 and 1920 was due to the assignment of some of the deaths which would otherwise have been classified under this rubric to arterio-sclerosis, and that during this period the balance of the rates as between these two rubrics became stabilized.

While the older physicians were careful observers and possessed many criteria, such as the character of the pulse, shortness of breath, pain in the region of the heart, evidences of engorgement of the lungs, blueness of the skin, and the like, upon which to base diagnosis of heart disease, the use of refined methods is nowhere more necessary for accuracy than in the field of cardiac disease. It was pointed out in another section that previous to 1890 no large proportion of Baltimore physicians had had opportunity for accurate training in palpitation, percussion, and auscultation of the chest. The more recently introduced instruments of precision, the blood-pressure gauge and the electrocardiogram, must have tended to augment appreciably the proportion of deaths ascribed to cardiac disease. On the whole, during the past 30 years many events have conspired to increase the mortality-rates for heart and kidney diseases and general arterio-sclerosis by increasing precision in diagnosis. It is evident from the tables that at least some of the increase in the rates for these three rubrics, organic heart disease, arterio-sclerosis, and nephritis, has been at the expense of the rubric dropsy, which has declined as the others have risen. This is not surprising, because the affections included under these rubrics embrace all the pathological states responsible in significant degree for general dropsy. Therefore, while the deaths ascribed to dropsy can not be apportioned correctly among the other three rubrics, it follows that the sum of the rates for the four rubrics must express with some degree of nearness actual observed experience for the group as a whole. When this was done (table 110), the combined rate fell steadily from 82 for 1812–1815 to 41 for 1831–1835, and then rose during the following 20 years to 114 for 1851–1855, a rate maintained for 15 years. Between 1866 and 1880, the rate fluctuated between 137 and 145. After 1880, when the rate for dropsy had become insignificant, the rates for this group continued to ascend uninterruptedly, but by unequal steps, to 388 for the period 1916–1920. The relatively slight changes in the combined rate for these affections between 1906 and 1920 was associated with stabilized rates for arterio-sclerosis and nephritis and with ascending rates for cardiac disease. Whatever the explanation may be, the rates for this group, as judged from the officially recorded figures, fell by 50 per cent between 1812 and 1835, but by 1850 had surpassed the former high level. When the course of the rates for this group is compared with that of the rates for senility and causes unknown in adults (table 110) in the earlier years, in general the rates for the latter were high or indeed often rising when

the former were falling or at least low. During the period of increase in precision of diagnosis between 1880 and 1905 the rates for senility and for causes unknown fell, while those for the cardio-vascular-renal group rose. Although the assumption that all the deaths classified under the rubrics senility and causes unknown in adults should have been assigned to cardio-vascular-renal diseases is by no means warranted, it is probable that a very large moiety of the number properly belonged under those rubrics. Since 1905, while precision of diagnosis in this group of diseases has probably advanced but slightly, but classification of the certified causes of death has become more exact, the rates for senility and causes unknown have fallen to negligible levels and the mortality for cardiac, renal, and arterial disease (exclusive of apoplexy) taken together has become more stable (column 5, table 110). It is reasonable to suppose that some of the increase in the recorded mortality from these diseases is dependent upon changes in the age distribution of the population resulting in a gradual increase in the proportion of persons in the age-groups in which their force of mortality is naturally high. However, rates corrected for age indicate that between 1830 and 1920 for heart disease less than 5 per cent, and for apoplexy less than 30 per cent, of the rise in rates can be explained by this factor.

When the rates for apoplexy are combined with those for cardiac and renal diseases and for arterio-sclerosis and dropsy (column 7, table 110), until 1870 the shape of the curve is very close to that of the total rates for the other numbers of the group without apoplexy (column 5, table 110). After 1870, the ascent in the curve for the former is much steeper and smoother than that for the latter. The sum of the rates for the five rubrics, heart, renal, and arterial disease, dropsy, and apoplexy, must be taken as measuring the course of the lethal force of cardio-vascular-renal affections as indicated by the official records. Thus viewed (column 7, table 110, graph 28), the mortality-rate which stood at 92 between 1812 and 1815 and rose to 109 between 1816 and 1820, fell almost unbrokenly during the succeeding 25 years to 73 between 1841 and 1845. In the next quinquennium the rate approached closely its previous highest level, and from 1851 to 1865 it varied between 132 and 139. Between 1866 and 1895 the rate more than doubled. By steady progression it rose from 332 for 1896–1900 to 508 for the quinquennium ending in 1920. Thus measured it appears, then, that the recorded mortality from this group of affections increased by over 450 per cent between 1812 and 1815 and 1916 and 1920.

For the years 1918–1920, inclusive, data are available for estimating the influence of race and sex upon mortality from these four rubrics. Rates specific for these attributes are presented in table 115. Taking the rates averaged for the three years, it will be noted that for each rubric except arterio-sclerosis the rates are higher in negroes than in whites, and that among the latter there are no significant differences in the rates for the two sexes in any of the rubrics. Among negroes the rates were significantly higher in males for heart disease and in females for apoplexy. The total averaged rates for the four rubrics taken together were 510 for the whole population, 470 and 741 for whites and negroes, 465 and 471 for male and female whites, and 739 and 742 for male and female negroes, respectively.

This extraordinary rise in the rates for this group of diseases in the more than 100 years under review is satisfactorily explained neither by errors of diagnosis and faults of statistical classification, nor by changes in the age and race groupings of the population. It has been found that when all the deaths attributed to senility and causes unknown in adults—the only two rubrics available for hiding in earlier years any considerable proportion of deaths due to the group of cardio-vascular-renal disease now under consideration—are by the most liberal interpretation assigned to the latter group, the balance remains far from equal. Assuming that the changes in the age distribution of the population exerted the same influence upon the rates for nephritis,

TABLE 115.—*Number of deaths and rate of death, per 100,000 living inhabitants, from organic diseases of the heart, softening of the brain and apoplexy, nephritis, and arterio-sclerosis, according to color and sex, for 1918, 1919, and 1920, with their respective averaged rates for the 3-year period 1918-1920.*

D = death. R = rate.

Disease.	Year.	Total.		White.						Colored.					
				Total.		Male.		Fem.		Total.		Male.		Fem.	
		D	R	D	R	D	R	D	R	D	R	D	R	D	R
Organic diseases of the heart	1918	1533	248	1128	217	585	228	543	207	405	409	194	428	211	393
	1919	1270	176	967	157	471	153	496	160	303	291	158	330	145	257
	1920	1366	186	1061	170	510	165	551	174	305	282	161	302	144	260
	Average ...	....	203	....	181	...	182	...	181	...	327	...	354	...	303
Softening of the brain and apoplexy	1918	835	135	652	126	302	118	350	134	183	185	69	152	114	212
	1919	838	116	676	110	316	103	360	116	162	155	60	125	102	181
	1920	823	112	650	104	297	96	353	111	173	159	67	126	106	191
	Average ...	....	121	....	113	...	106	...	120	...	166	...	134	...	195
Nephritis	1918	1150	186	888	171	466	181	422	161	262	265	126	278	136	253
	1919	1137	158	903	146	434	141	469	151	234	224	107	224	127	225
	1920	1091	149	861	138	448	145	413	130	230	212	112	210	118	213
	Average ...	....	164	....	152	...	156	...	148	...	234	...	237	...	230
Arterio-sclerosis	1918	169	27	152	29	82	32	70	27	17	17	10	22	7	13
	1919	144	20	129	21	57	19	72	23	15	14	5	10	10	18
	1920	115	16	105	17	49	16	56	18	10	9	5	9	5	9
	Average ...	....	21	....	22	...	22	...	23	...	14	...	14	...	13

arterio-sclerosis, and dropsy as for heart disease and for apoplexy, a large gap yet remains to be filled. During the period of rising rates, the negro, with his conspicuously higher death-rates from this group of diseases, has steadily decreased in numerical proportion to the white in the population. In regard to the possible influence of sex, there has been no considerable variation in the proportion of males and females in the population. All things measurable considered, the conclusions seems inevitable that since 1870 there has been a progressive but gradual actual increase in the mortality from cardio-vascular-renal disease, independent of changes in race and age composition of the population.

According to the experience of 1910 and 1920, when rates specific for age may be calculated with a reasonable degree of accuracy, the mortality from

cardio-vascular-renal disease was limited very largely, though by no means entirely, to individuals of 40 years of age and over. It has been shown that since 1850, at least, this age group of the population has increased very considerably in its proportional relations to the whole. Therefore, rates calculated from the combined mortality figures for all these rubrics in the census years 1850 to 1920, inclusive, on the basis populations in this age-group should be, within a moderate degree of error, specific for age. The results of such a calculation are presented in table 116 and graph 29. Judged by this criterion, admittedly lacking in absolute exactness, there was singularly little change in the rate of mortality from these affections between 1850 and 1870. Between 1870 and 1910 the rate ascended by regular steps, with the result that in this period the mortality was nearly doubled; but in 1920 the rate was lower than in 1890 and but little higher than in 1880. In so far as conclusions may be justified from these premises, in which no allowances are made for the influence of such important factors as color and sex, it appears that, while mortality

TABLE 116.—*Number of deaths and rate of death, per 100,000 living inhabitants over 40 years of age, from cardio-vascular-renal diseases, for the decennia 1830 to 1920, inclusive.**

D = death. R = rate.

Year.	D	R	Year.	D	R
1830 ..	63	278	1880 ..	737	958
1840 ..	96	601	1890 ..	1184	1141
1850 ..	225	777	1900 ..	1783	1413
1860 ..	285	712	1910 ..	2511	1656
1870 ..	438	780	1920 ..	2225	1066

* The number of deaths for each decennium is a 3-year average of that obtaining in the decennial year and in those years immediately preceding and following, except in 1920, when the average is for 1919 and 1920 only.

from cardio-vascular-renal disease has increased considerably since 1850, the actual increase has been much less than indicated by the crude rates. In fact, when correction is made for age in this in some respects crude fashion, it seems certain that mortality from this group of causes really declined between 1910 and 1920 and that the rate was actually lower in 1920 than in 1890.

Further consideration of this table brings to light two facts that demand explanation. The rates were much higher in 1850 than in 1860 and considerably lower in 1920 than in 1890, although they rose sharply between 1840 and 1850 and steadily between 1890 and 1910. If these mortality-rates possess any significant basis of trustworthiness, some more reasonable explanation than changes in statistical classification is necessary. Here is a compound group of chronic organic diseases whose mortality-rates reasonably specific for age run a course similar to those of some specific infectious disease. In this peculiarity lies a plausible partial solution of the mystery. Many statisticians, of whom Bertillon (64) and Pearl (65) are to be especially mentioned in this connection, have observed that one of the most conspicuous immediate effects of epidemic influenza is to raise the mortality from the group

of causes here grouped under cardio-vascular affections. The ascent in the rate for 1850 corresponds to the influenza epidemic of 1849–1850, which apparently died out at once, without becoming endemic. Its effects, whatever their other characters, were sharp and transient, and therefore made no permanent impression. The impact of the pandemic of 1890 was associated with a sharp rise in the rate for cardio-vascular-renal diseases, which was, however, not transient, but lasting. The mortality continued to rise through the next two decennia and well into the third (through 1918). But, as has been shown in the discussion of influenza, this disease also changed its habit and, instead of disappearing, settled into endemicity. It may well be that in each year between 1891 and 1917 endemic influenza killed off a certain proportion of the susceptible weaklings among the cardio-vascular-renally afflicted population, and in the pandemic of 1918 this crop was harvested in even greater numbers than usual. The sharp decline in the rate for cardio-vascular-renal affections during the three following years (reflected in the rate for 1920 in table 101), while influenza continued endemic, would be explained for the same reasons by the unusually heavy losses in 1918.

The chief objections to this argument are: (1) The mortality from these affections rose between 1861 and 1880, in a period without influenza, and (2) if endemic influenza operated so effectively for the 27 years after 1890, long before the expiration of this time it should have so seriously depleted its store of possible victims, that the rate for cardio-vascular-renal diseases should have fallen in comparatively few years to much lower levels. The most ready escape from this dilemma is to assume that a very large part in the causation of this disease-group, or at least of its most prominent member, heart disease, is borne by the common communicable diseases (including influenza), many of which were at this acme in the seventh, eighth, and ninth decennia of the last century, and that since their decline endemic influenza has in a large measure taken on this rôle. However this may be, it seems certain that the death-rate of cardio-vascular-renal disease has been determined, at times at least, in some significant measure by influenza.

The general biological implications of the effects of the febrile diseases upon the course of mortality from this set of causes will be considered further under the discussion changes of the death-rate from all causes.

Chapter XV.—Diseases of the Central Nervous System and Liver; Diabetes; Alcoholism.

(Tables 117 to 119.)

CHRONIC DISEASES OF THE CENTRAL NERVOUS SYSTEM.

To the rubric palsy, later changed to paralysis in 1874 and to paralysis without specified cause in 1899, a gradually increasing number of deaths were credited each year from 1812 to 1892 (table 117). Since the latter date, with the gradual increase in the proportional allotment of deaths from diseases of the nervous system to other rubrics, this rubric declined in relative importance, and, with the revision of the international classification effective in 1910, as rubric 66, sank into comparative obscurity.

In order of their entrance into the statistical nosology, there appeared epilepsy in 1827, chorea in 1837, locomotor ataxia in 1878, general paralysis of the insane in 1899, other diseases of the spinal cord in 1902, and other diseases of the nervous system in 1910. It is to be presumed that, until and unless specifically assigned to these other rubrics, deaths due to primary diseases of the nervous system associated with paralysis (and this excludes of course apoplexy, hemorrhage, congestion, and softening or mechanical injury of the brain, all considered elsewhere) were classified under the original rubric palsy or its successor, rubric 66.

The mortality-rates for these rubrics, separate and combined, as averaged for quinquennial periods, are presented in table 118. As it is not possible to follow the deaths from insanity with any certainty, they have been left out of consideration. It will be noted that while the rates for chorea varied from time to time, this affection has not been an important cause of death. The rates for epilepsy assume importance only after 1870, and since this date they have not risen above 4 nor fallen below 2. Somewhat lower rates have prevailed for locomotor ataxia (1 to 3) since 1880. This affection reached its highest recorded mortality level in 1901–1910. The rate for general paralysis rose from 3 in 1901–1905 to 5 in 1906–1915, but during the last quinquennium fell to 3. The decrease in the rates for both these two forms of syphilis of the nervous system during the period 1916–1920 was due to the fact that owing to a change in custom of classification of deaths an increasingly large proportion of deaths ascribed to them have been classified under syphilis. During the 10-year period 1911–1920, the new rubric, other diseases of the nervous system (number 74), has come into prominence with rates of 5 and 6 during the two quinquennia.

It will be observed that, for practical purposes, the old rubric palsy or paralysis unspecified held the ground almost unchallenged during the nineteenth century, and that only since 1900, with the full differentiation of other rubrics, has it receded in importance.

Considering this group of affections of the nervous system as a whole, the quinquennial rates rose from 15 for 1812–1815 to 21 during the following 10 years. Falling during a period of 20 years after 1825 and reaching the

TABLE 117.—*Number of deaths and rate of death, per 100,000 living inhabitants, from alcoholism, chronic diseases of the central nervous system, diseases of the liver and biliary tract, and diabetes, from 1812 to 1920, inclusive.*

D = death. R = rate.

Year.	Alcoholism.						Chronic diseases of the central nervous system.																Diseases of liver and biliary tract.				Diabetes.	
	Intemperance.		Delirium tremens.		Total.		Chorea.		Epilepsy.		Locomotor ataxia.		Other diseases of spinal cord.		General paralysis.		Other diseases of nervous system.		Paralysis unspecified.		Total.		Cirrhosis of liver.		Total.			
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1812	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	14	34	14	34	...	...	6	15	...	...
1813	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	4	3	4	...	...	1	2	...	...
1814	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	11	5	11	...	...	8	18	...	...
1815	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	11	5	11	...	...	12	26	...	...
1816	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	20	10	20	...	...	12	25	...	...
1817	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	20	10	20	...	...	8	16	...	...
1818	14	26	...	...	14	26	...	...	...	...	...	...	...	...	...	...	...	...	12	23	12	23	...	...	4	8	...	...
1819	46	83	...	...	46	83	...	...	...	...	...	...	...	...	...	...	...	...	7	13	7	13	...	...	2	4	...	...
1820	29	50	...	...	29	50	...	...	...	...	...	...	...	...	...	...	...	...	17	29	17	29	...	...	16	28	...	...
1821	47	78	...	...	47	78	...	...	...	...	...	...	...	...	...	...	...	...	18	30	18	30	...	...	22	36	...	...
1822	47	75	...	...	47	75	...	...	...	...	...	...	...	...	...	...	...	...	19	30	19	30	...	...	47	75	...	...
1823	25	38	...	...	25	38	...	...	...	...	...	...	...	...	...	...	...	...	11	17	11	17	...	...	18	28	...	...
1824	25	37	...	...	25	37	...	...	...	...	...	...	...	...	...	...	...	...	9	13	9	13	...	...	18	26	...	...
1825	21	30	...	...	21	30	...	...	...	...	...	...	...	...	...	...	...	...	11	16	11	16	...	...	27	38	...	...
1826	21	29	...	...	21	29	...	...	...	...	...	...	...	...	...	...	...	...	14	19	14	19	...	...	29	39	...	...
1827	22	29	...	...	22	29	...	...	1	1	...	...	...	...	...	...	...	...	11	14	12	16	...	...	12	16	...	...
1828	12	15	...	...	12	15	...	...	...	...	...	...	...	...	...	...	...	...	20	25	20	25	...	...	34	43	...	...
1829	32	39	...	...	32	39	...	...	...	...	...	...	...	...	...	...	...	...	5	6	5	6	...	...	26	31	...	...
1830	25	29	...	...	25	29	...	...	...	...	...	...	...	...	...	...	...	...	15	18	15	18	...	...	26	30	...	...
1831	45	51	...	...	45	51	...	...	...	...	...	...	...	...	...	...	...	...	11	12	11	12	...	...	25	28	...	...
1832	40	43	...	...	40	43	...	...	...	...	...	...	...	...	...	...	...	...	8	9	8	9	...	...	24	26	...	...
1833	25	26	...	...	25	26	...	...	...	...	...	...	...	...	...	...	...	...	19	20	19	20	...	...	22	23	...	...
1834	34	34	...	...	34	34	...	...	2	2	...	...	...	...	...	...	...	...	10	10	12	12	...	...	17	17	...	...
1835	41	40	...	...	41	40	...	...	1	1	...	...	...	...	...	...	...	...	12	12	13	13	...	...	11	11	...	...
1836	50	47	...	...	50	47	...	...	...	...	...	...	...	...	...	...	...	...	13	12	13	12	...	...	24	23	...	...
1837	35	32	...	...	35	32	2	2	...	...	...	...	...	...	...	...	...	...	12	11	14	13	...	...	16	15	...	...
1838	47	41	...	...	47	41	...	...	1	1	...	...	...	...	...	...	...	...	18	16	19	17	...	...	16	14	...	...
1839	30	26	...	...	30	26	1	1	...	...	...	...	...	...	...	...	...	...	12	10	13	11	...	...	12	10	...	...
1840	35	29	...	...	35	29	...	...	...	...	...	...	...	...	...	...	...	...	24	20	24	20	...	...	12	10	...	...
1841	29	23	...	...	29	23	...	...	...	...	...	...	...	...	...	...	...	...	13	10	13	10	...	...	8	6	...	...
1842	18	14	...	...	18	14	1	1	...	...	...	...	...	...	...	...	...	...	1	1	2	2	...	...	18	14	...	...
1843	15	11	...	...	15	11	...	...	...	...	...	...	...	...	...	...	...	...	21	16	21	16	...	...	11	8	...	...

1844	10	7	1	1	11	8	...	...	...	...	...	...	...	...	...	...	...	...	21	15	21	15	...	...	20	15	...	...
1845	20	14	3	2	23	16	...	...	...	...	...	...	...	...	...	...	...	...	28	20	28	20	...	...	13	9	...	...
1846	16	11	3	2	19	13	...	...	...	...	...	...	...	...	...	...	...	...	16	11	16	11	...	...	17	12	...	...
1847	16	11	4	3	20	13	...	...	...	...	...	...	...	...	...	...	...	...	35	23	35	23	...	...	1	1	1	1
1848	23	15	6	4	29	19	...	...	...	...	...	...	...	...	...	...	...	...	34	22	34	22	...	...	1	1	...	...
1849	33	21	5	3	38	24	...	...	...	...	...	...	...	...	...	...	...	...	46	29	46	29	...	...	5	3	...	...
1850	24	15	6	4	30	18	...	...	...	...	...	...	...	...	...	...	...	...	42	26	42	26	...	...	18	11	...	...
1851	28	17	7	4	35	21	...	...	...	...	...	...	...	...	...	...	...	...	47	28	47	28	...	...	22	13	2	1
1852	34	20	8	5	42	24	1	1	...	...	...	...	...	...	...	...	...	...	34	20	35	20	...	...	16	9	1	1
1853	30	17	4	2	34	19	...	...	...	...	...	...	...	...	...	...	...	...	36	20	36	20	...	...	19	11	...	...
1854	23	13	8	4	31	17	...	...	...	...	...	...	...	...	...	...	...	...	38	21	38	21	...	...	24	13	8	4
1855	13	7	3	2	16	9	...	...	...	...	...	...	...	...	...	...	...	...	38	20	38	20	...	...	34	18	...	...
1856	22	12	4	2	26	13	1	1	...	...	...	...	...	...	...	...	...	...	46	24	47	24	...	...	30	16	...	...
1857	18	9	3	2	21	11	...	...	...	...	...	...	...	...	...	...	...	...	49	25	49	25	...	...	25	13	...	...
1858	21	10	9	4	30	15	...	...	...	...	...	...	...	...	...	...	...	...	52	26	52	26	...	...	17	8	...	...
1859	24	14	3	2	27	13	...	...	...	...	...	...	...	...	...	...	...	...	42	20	42	20	...	...	29	14	1	...
1860	27	13	7	3	34	16	...	...	...	...	...	...	...	...	...	...	...	...	48	22	48	22	...	...	30	14	...	...
1861	27	12	4	2	31	14	1	...	...	...	...	...	...	...	...	...	...	...	55	25	56	25	...	...	22	10	...	...
1862	18	8	3	1	21	9	1	...	...	...	...	...	...	...	...	...	...	...	74	33	75	33	...	...	19	8	...	...
1863	11	5	1	...	12	5	1	...	1	...	...	...	...	...	...	...	...	...	70	30	72	31	...	...	23	10	...	...
1864	14	6	2	1	16	7	...	...	...	...	...	...	...	...	...	...	...	...	79	33	79	33	...	...	19	8	...	...
1865	8	3	...	...	8	3	1	...	...	...	...	...	...	...	...	...	...	...	50	21	51	21	...	...	17	7	...	...
1866	2	1	3	1	5	2	1	...	3	1	...	...	...	...	...	...	...	...	70	28	74	30	...	...	15	6	...	...
1867	1	...	2	1	3	1	...	...	2	1	...	...	...	...	...	...	...	...	69	27	71	28	...	...	24	9	...	...
1868	3	1	1	...	4	2	...	...	1	...	...	...	...	...	...	...	...	...	89	34	90	35	...	...	20	8	1	...
1869	3	1	1	...	4	2	...	...	5	2	...	...	...	...	...	...	...	...	93	35	98	37	...	...	24	9	...	...
1870	9	3	3	1	12	4	...	...	4	1	...	...	...	...	...	...	...	...	105	39	109	40	...	...	34	12	1	...
1871	8	3	4	1	12	4	...	...	3	1	...	...	...	...	...	...	...	...	81	29	84	30	...	...	30	11	...	...
1872	11	4	3	1	14	5	1	...	...	...	...	...	...	...	...	...	...	...	121	42	122	43	...	...	41	14	...	...
1873	9	3	1	...	10	3	3	1	6	2	...	...	...	...	...	...	...	...	132	45	141	48	...	...	48	16	2	1
1874	11	4	6	2	17	6	1	...	11	4	...	...	...	...	...	...	...	...	117	39	129	43	...	...	50	17	2	1
1875	40	13	4	1	44	14	2	1	18	6	...	...	...	...	...	...	...	...	101	33	121	40	5	2	42	14	5	2
1876	18	6	5	2	23	7	1	...	15	5	...	...	...	...	...	...	...	...	80	26	96	31	28	9	60	19	7	2
1877	29	9	3	1	32	10	4	1	14	4	...	...	...	...	...	...	...	...	112	35	130	41	27	8	69	22	7	2
1878	27	8	7	2	34	10	...	...	11	3	1	...	...	...	...	...	...	...	146	45	158	49	21	6	61	19	3	1
1879	21	6	6	2	27	8	...	...	14	4	2	1	...	...	...	...	...	...	141	43	157	47	23	7	68	21	6	2
1880	27	8	5	1	32	9	...	...	14	4	3	1	...	...	...	...	...	...	138	41	155	46	28	8	60	18	6	2
1881	28	8	15	4	43	12	2	1	17	5	1	...	...	...	...	...	...	...	136	39	156	45	26	8	82	24	5	1
1882	33	9	8	2	41	12	1	...	11	3	4	1	...	...	...	...	...	...	160	45	176	50	33	9	73	21	8	2
1883	42	12	3	1	45	13	...	...	18	5	2	1	...	...	...	...	...	...	178	49	198	55	35	10	87	24	9	3
1884	34	9	3	1	37	10	2	1	15	4	3	1	...	...	...	...	...	...	146	40	166	45	37	10	87	24	10	3
1885	30	8	1	...	31	8	1	...	9	2	5	1	...	...	...	...	...	...	192	51	207	55	43	11	85	23	14	4
1886	33	9	5	1	38	10	2	1	17	4	6	2	...	...	...	...	...	...	181	47	206	54	39	10	79	21	11	3
1887	33	8	5	1	38	10	5	1	10	3	6	2	...	...	..	...	...	...	169	43	190	49	39	10	90	23	18	5

TABLE 117.—*Number of deaths and rate of death, per 100,000 living inhabitants, from alcoholism, chronic diseases of the central nervous system, diseases of the liver and biliary tract, and diabetes, from 1812 to 1920, inclusive.*—Continued.

Year.	Alcoholism.						Chronic diseases of the central nervous system.																Diseases of liver and biliary tract.				Diabetes.	
	Intemperance.		Delirium tremens.		Total.		Chorea.		Epilepsy.		Locomotor ataxia.		Other diseases of spinal cord.		General paralysis.		Other diseases of nervous system.		Paralysis unspecified.		Total.		Cirrhosis of liver.		Total.			
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1888	36	9	3	1	39	9	...	...	15	4	6	1	...	...	...	...	...	...	171	41	192	46	68	16	109	26	19	5
1889	34	8	3	1	37	9	2	...	24	6	...	...	...	...	...	...	...	...	221	52	247	58	52	12	89	21	14	3
1890	16	4	8	2	24	6	1	...	14	3	6	1	...	...	...	...	...	...	214	49	235	54	40	9	97	22	19	4
1891	37	8	6	1	43	10	...	...	17	4	11	2	...	...	...	...	...	...	243	55	271	61	61	14	107	24	26	6
1892	33	7	2	...	35	8	1	...	8	2	9	2	...	...	...	...	...	...	259	58	277	62	55	12	91	20	19	4
1893	29	6	3	1	32	7	...	...	19	4	10	2	...	...	...	...	...	...	248	54	277	61	61	13	101	22	30	7
1894	14	3	9	2	23	5	2	...	15	3	3	1	...	...	...	...	...	...	216	47	236	51	44	9	90	19	36	8
1895	28	6	2	...	30	6	2	...	19	4	12	3	...	...	...	...	...	...	231	49	264	56	57	12	108	23	39	8
1896	27	6	2	...	29	6	1	...	9	2	15	3	...	...	...	...	...	...	220	46	245	51	51	11	96	20	44	9
1897	14	3	2	...	16	3	2	...	13	3	7	1	...	...	...	...	...	...	218	45	240	49	52	11	96	20	31	6
1898	23	5	3	1	26	5	4	1	10	2	10	2	...	...	...	...	...	...	206	42	230	47	61	12	98	20	37	8
1899	31	6	...	...	31	6	2	...	11	2	9	2	...	...	14	3	...	...	201	40	237	47	67	13	126	25	42	8
1900	41	8	...	...	41	8	2	...	16	3	10	2	...	...	3	1	...	...	177	35	208	41	56	11	125	25	35	7
1901	31	6	...	...	31	6	...	...	20	4	11	2	...	...	3	1	...	...	180	35	214	42	53	10	102	20	49	10
1902	46	9	...	1	46	9	1	...	20	4	9	2	31	6	12	2	...	...	162	31	235	45	72	14	132	25	46	9
1903	46	9	...	...	46	9	2	...	19	4	15	3	30	6	13	2	...	...	165	31	244	46	65	12	124	24	55	10
1904	41	8	...	...	41	8	2	...	12	2	17	3	21	4	32	6	...	...	159	30	243	46	70	13	131	25	57	11
1905	58	11	...	...	58	11	2	...	21	4	19	4	31	6	32	6	...	...	143	26	248	46	82	15	125	23	56	10
1906	59	11	...	...	59	11	1	...	18	3	10	2	28	5	30	5	...	...	131	24	218	40	78	14	125	23	72	13
1907	53	10	...	...	53	10	1	...	19	3	17	3	34	6	36	7	...	...	181	33	288	52	69	12	143	26	83	15
1908	46	8	...	...	46	8	...	..	18	3	15	3	26	5	29	5	...	...	168	30	256	46	65	12	130	23	61	11
1909	40	7	...	...	40	7	3	1	15	3	18	3	24	4	23	4	...	...	144	25	227	40	90	16	134	24	67	12
1910	49	9	...	...	49	9	1	...	28	5	13	2	29	5	29	5	24	4	122	21	246	43	56	10	117	20	93	16
1911	46	8	...	...	46	8	1	...	19	3	14	2	36	6	29	5	41	7	108	19	248	43	98	17	165	29	98	17
1912	49	8	...	...	49	8	2	...	15	3	17	3	39	7	16	3	35	6	129	22	253	43	71	12	109	19	88	15
1913	57	10	...	...	57	10	1	...	12	2	11	2	14	2	8	1	27	5	121	21	194	33	83	14	120	20	87	15
1914	55	9	...	...	55	9	2	...	22	4	14	2	25	4	28	5	22	4	90	15	203	34	76	13	120	20	115	19
1915	30	5	...	...	30	5	1	...	15	2	11	2	20	3	30	5	18	3	67	11	162	27	71	12	116	19	109	18
1916	32	5	...	...	32	5	1	...	13	2	9	1	15	2	29	5	41	7	43	7	151	25	83	14	144	24	122	20
1917	37	6	...	...	37	6	...	...	14	2	16	3	29	5	28	5	40	7	32	5	159	26	96	16	138	23	124	20
1918	26	4	...	...	26	4	...	...	8	1	9	1	28	5	23	4	36	6	18	3	122	20	63	10	110	18	119	19
1919	14	2	...	...	14	2	2	...	17	2	5	1	23	3	2	...	43	6	31	4	123	17	66	9	113	16	145	20
1920	4	1	...	...	4	1	1	...	16	2	3	...	28	4	4	1	35	5	27	4	114	16	53	7	112	15	155	21

level of 13 for the quinquennium 1841–1845, the rate rose to 22 in 1846–1850, and remained near this level until 1860. By gradual steps the averaged rate ascended during the next 35 years, and attained its highest level, 58 in 1891–1895. From this level, during the next three quinquennia, the rate declined somewhat gradually to 44 in 1906–1910. The rate fell to 36 in 1911–1915 and to 21 in 1916–1920. The very distinct rise between 1860 and 1895 in the mortality-rates for paralysis is difficult to explain. It is not possible

TABLE 118.—*Average rate of death, per 100,000 living inhabitants, by 5-year periods, from alcoholism, chronic diseases of the central nervous system, diseases of the liver and biliary tract, and diabetes, from 1812 to 1920, inclusive.*

Periods.	Alcoholism.	Chronic diseases of the central nervous system.								Diseases of liver and biliary tract.		Diabetes.
		Chorea.	Epilepsy.	Locomotor ataxia.	Other diseases of spinal cord.	General paralysis.	Other diseases of nervous system.	Paralysis unspecified.	Total.	Cirrhosis of liver.	Total.	
1812-15	....	....	....	....	....	....	....	15	15	....	12	....
1816-20	53	....	....	....	....	....	....	21	21	....	16	....
1821-25	51	....	....	....	....	....	....	21	21	....	41	....
1826-30	28	....	....	....	....	....	....	16	17	....	32	....
1831-35	39	....	....	....	....	....	....	13	13	....	21	....
1836-40	35	0.53	....	....	....	....	....	14	15	....	14	....
1841-45	15	0.16	....	....	....	....	....	12	13	....	10	....
1846-50	17	....	....	....	....	....	....	22	22	....	5	....
1851-55	18	0.12	....	....	....	....	....	22	22	....	13	1
1856-60	14	0.10	....	....	....	....	....	23	23	....	10	....
1861-65	8	0.35	....	....	....	....	....	28	29	....	9	....
1866-70	2	0.08	1	....	....	....	....	33	34	....	9	....
1871-75	7	0.48	3	....	....	....	....	38	41	....	14	1
1876-80	9	0.32	4	0.36	....	....	....	38	43	8	20	2
1881-85	11	0.33	4	1	....	....	....	45	50	10	23	3
1886-90	9	0.50	4	1	....	....	....	47	52	12	23	4
1891-95	7	0.21	3	2	....	....	....	52	58	12	22	7
1896-1900	6	0.44	2	2	....	1	....	42	47	12	22	8
1901-05	8	0.26	3	3	4	3	....	31	45	13	23	10
1906-10	9	0.21	3	3	5	5	1	27	44	13	23	13
1911-15	8	0.24	3	2	5	4	5	18	36	14	21	17
1916-20	4	0.12	2	1	4	3	6	5	21	11	19	20

to arrive at a completely satisfactory explanation for the steady rise in the mortality-rate for paralysis in the period before the rubrics locomotor ataxia, general paralysis (of the insane), and other diseases of the spinal cord and of the nervous system assumed importance. This ascent in the rate may have been due in some measure to the possible inclusion of deaths that should have been classified under congestion, hemorrhage and softening of the brain, and insanity, and to a considerable increase in the prevalence of syphilis or of some other prominent cause or causes of chronic disease of the central nervous system. The decline in the rates for the rubric (paralysis, cause unspecified) since 1896 is accounted for partly by the establishment of the other rubrics to which deaths formerly allotted to it were assigned, and partly to an actual decrease in the deaths from diseases of this group. Similarly, the marked decline in the total rate since 1896, may be attributed to more careful classi-

fication of deaths, to more general and adequate treatment of syphilis, and to modifications in the death-rates from other diseases, which have claimed in more recent years individuals who in former years would have fallen victims to chronic disorders of the nervous system. It appears to be clear that to no one tangible factor can be credited the explanation of the course of the mortality-rates of this group of diseases as based upon officially recorded deaths during the more than 100 years under review. It will be noted that the averaged rates between 1816 and 1825, 1846 and 1860, were at the same general level (21) obtaining in 1916–1920, when great care was exercised in the accurate classification of deaths.

Rates specific for age and color for 1920 are given in table 119. In all categories, the mortality was light in the early years of life and increased with advancing age. In negroes, no deaths occurred in the first two decades of life, and in every age-group, except 80 years and over, the mortality was decidedly less than among whites. For all ages, the rate for whites was double that for negroes.

Since 1875, at least, this group of diseases of the nervous system has been studied intensively in Baltimore, first by F. T. Miles, and later by George Preston, H. J. Berkley, William Osler, H. M. Thomas, and others, from whom the general practitioner has had large opportunity to acquaint himself with their recognition.

DISEASES OF THE LIVER.

Under one heading or another, deaths from affections of the liver (table 117) may be followed continuously since 1812. Jaundice persisted as a separate rubric from 1812 to 1898. To inflammation of the liver deaths were attributed in most years between 1814 and 1897. Other rubrics were liver complaint, from 1820 to 1874; liver abscess, in 1821 and 1822 and from 1878 to 1898; cirrhosis, since 1875; acute yellow atrophy and gall stones, since 1878; and other diseases of the liver since 1899. The sum of these represents the number of deaths attributed to disease of the liver, cancer excepted. For various reasons, cirrhosis of the liver is the only member of the group whose course it is worth while to follow separately. There is ample reason to conclude that, in the earlier years at least, the officially recorded mortality from liver disease has fallen short of actual occurrence. In table 118 the course of the force of recorded mortality from diseases of the liver as a group and for cirrhosis separately may be followed from rates averaged for quinquennial periods. It will be observed that the rates for the total rose from 12, for 1812–1815, to 16 during the succeeding 5 years, and ascended abruptly to 41, the highest level attained, in 1821–1825. During the next 25 years the rate steadily and gradually declined to 5 during the quinquennium 1846–1850. Between 1851 and 1875 the averaged rate did not exceed 14 nor fall below 9. Coincident with the appearance of cirrhosis of the liver in the statistical classification in 1875, the rate jumped from 14 for 1870–1875 to 20 for 1876–1880. From 1881 there was remarkably little change in the rate. In the 8 quinquennia rates of 23 obtained in 4, 22 in 2, and 21 and 19 in one each. Similarly, the rate for cirrhosis of the liver varied within narrow limits during this period. Starting from 10 for 1881–1885 and remaining at 12 from 1886 to 1900, and at 13 from 1901 to 1910, the averaged rate rose to 14 in 1911–1915, to fall to 11 in 1916–1920. The stability of the rate for this affection during the 40 years is striking.

It is evident that from 1876 to 1885 somewhat less and after 1886 somewhat more than half the deaths recorded as caused by disease of the liver and its ducts were contributed by cirrhosis. It would seem that in the earlier years this affection, when recognized, was classified largely under liver complaint and inflammation of the liver, and that before its establishment as a separate rubric it must have been either of less common occurrence than later, was classified elsewhere, or was frequently unrecognized. It appears from table 119 in which are given the rates for age and color for the year 1920, there is but little difference in mortality as between whites and negroes. For whites, with an insignificant mortality before the fortieth year, the rate advances steadily to its highest level in the age-period 80 years and over. Among negroes there were no deaths before the fortieth and after the seventieth years of age, and the highest rate occurred in the seventh decade of life.

DIABETES.

This long-known disease was not recognized in the local statistical nosology until 1847, when it was credited with 1 death (table 117). It appeared again

TABLE 119.—*Number of deaths and rate of death, per 100,000 living inhabitants, from chronic diseases of the central nervous system, cirrhosis of the liver, and diabetes, according to age and color, for 1920.*

D = death. R = rate.

Age-periods.	Diseases of central nervous system.						Cirrhosis of liver.						Diabetes.					
	Total.		White.		Colored.		Total.		White.		Colored.		Total.		White.		Colored.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
Under 1 year....	...	...	...	...	..	...	..	..	..	..	..	..	...	...	...	...	..	...
1 to 4 years....	1	2	1	2	..	...	..	..	..	..	..	..	1	2	1	2	..	...
5 to 9 years....	3	5	3	5	..	...	..	..	..	..	..	..	1	2	1	2	..	...
0 to 9 years....	4	3	4	3	..	...	..	..	..	..	..	..	2	1	2	2	..	...
10 to 19 years....	6	5	6	6	..	...	..	..	..	..	..	..	2	2	2	2	..	...
20 to 29 years....	12	8	10	8	2	8	1	1	1	1	..	..	10	7	10	8	..	...
30 to 39 years....	13	11	12	12	1	5	2	2	2	2	..	..	7	6	5	5	2	9
40 to 49 years....	18	19	17	22	1	6	10	11	8	10	2	13	20	22	14	18	6	39
50 to 59 years....	18	29	17	31	1	13	12	19	9	16	3	38	40	64	36	66	4	51
60 to 69 years....	17	47	15	46	2	58	18	50	16	49	2	58	50	139	45	138	5	145
70 to 79 years....	19	132	18	138	1	74	8	56	8	61	..	..	21	146	20	153	1	74
80 years and over	8	230	7	224	1	282	2	57	2	64	..	..	3	86	3	96	..	...
Total	115	16	106	17	9	8	53	7	46	7	7	6	155	21	137	22	18	17

in 1851 and 1852, with 2 and 1 deaths, respectively, and in 1854 with 8 deaths. After appearing again in 1859, 1868, and 1870 with 1 death in each year, this disease took a permanent place in the mortality records in 1873. The rates averaged for 5-year periods are given in table 118. As determined by recorded deaths, the force of mortality of diabetes has risen by very gradual steps from an insignificant level (rate of 1) in 1871–1875 to one of considerable importance (rate of 20) by 1916–1920. By 1906–1910 its mortality-rate was equal to and by 1916–1920 was double that for cirrhosis of the liver. While some of this increase of importance of diabetes as a cause of death may be only apparent, and explainable by better medical diagnosis and more careful classification, there is little doubt that the larger part is real.

The influence of race and age upon the mortality from diabetes in 1920 is shown in table 119. The rate was 29 per cent greater in whites than in

negroes. For the whole population, the rate, which was only 1 in the first, 2 in the second, and 7 and 6 in the third and fourth decades, respectively, increased markedly in each succeeding decade until the eightieth year of life, after which there was a considerable fall. Among whites the mortality followed the same general course with the highest rates in the eighth decade. Among negroes there were no deaths earlier than the thirtieth year, and the highest rate occurred in the seventh decade of life.

ALCOHOLISM.

In the statistical records deaths have been attributed to alcoholism in each year since 1818. Deaths from this cause were classified under intemperance from 1818 to 1898, under delirium tremens from 1844 to 1898, and under alcoholism, acute and chronic (rubric 56) from 1899. Annual mortality-rates for these rubrics separate and combined, are given in table 117. It will be observed that for this cause of death intemperance was the sole rubric during the period of highest mortality and remained by far the most important rubric until its disappearance in 1899, and that, in consequence, during the 55 years of its presence in the statistical tables, to delirium tremens was ascribed but a small proportion of the total mortality from alcoholism. Deferring for the moment consideration of all questions in regard to their accuracy and taking the recorded figures at their face value in measuring the mortality from alcoholism, two features stand out prominently; first, the wide variations between the extremes of the annual rates, from 83 in 1819 to 1 in 1867 and in 1920, and second, the occurrence of several distinct waves, each extending over a considerable series of years and, with one exception, of progressively decreasing intensity. The first and highest wave, beginning with a rate of 26 in 1818 and reaching its peak with a rate of 83 in 1819, declined somewhat irregularly to the comparatively low level of 15 in 1828. The second wave, with its peak-rate of 51 in 1831, ended in 1844 with a rate of 8. The third wave, extending from 1845 to 1855, reached its highest point in 1849 and 1852 with a rate of 24 and fell to 9 in 1855. The fourth wave, with unusually low rates, lasted from 1856 to 1867. The fifth wave, long and irregular, reached its peak in 1875 with a rate of 14 and receded to its low point with a rate of 3 by 1897. In the last wave, which attained its highest level with a rate of 11 in 1905 and 1906, the decline was gradual though irregular until 1917, after which the descent was abrupt to a rate of 1 in 1920.

The progressively decreasing intensity of these waves of recorded mortality from alcoholism is well illustrated by the rates as averaged for 5-year periods (table 118). From an average height of over 50 up to 1825, by 1856–1860 the rate had fallen to 14, and from this time on was, with the exception of 1 quinquennial period, always under 10. Long before prohibition, the mortality officially ascribed to alcoholism had become almost negligible. Data for a comprehensive study of the relation of age, sex, and race to the mortality from alcoholism are lacking.

Unfortunately, there are no definite criteria for judging the degree of accuracy with which the recorded data represent the true lethal force of alcoholism. It is reasonable to suppose that, on account of the opprobrium attached to certain extreme types of over-indulgence in alcohol, for decedents of a

certain degree of social prominence, in many instances some other cause of death was reported, while for the relatively obscure the bald truth was stated. It may well be that in later years many deaths, which in earlier times and before the development of knowledge of pathological anatomy and pathogenesis would have been credited to alcoholism, were classified under chronic affections of particular organs, such as the heart, arteries, liver, kidneys, and nervous system, in the causation of which, for reasons more or less convincing, alcohol has been assigned a prominent part. The course of the annual rates during the last 60 years, when a rate of 10 has rarely been exceeded, suggests very strongly that some at least of the decrease in the recorded mortality is to be explained by changes in medical and statistical nosology resulting in crediting to alcoholism only those deaths occurring in delirium tremens or other pathological states indicative of acute or at least of actively progressive alcoholic poisoning. The relatively great decline in the rate, after 1918, which followed so abruptly upon the administrative interference with sale of alcohol supports this view, for had it at this time been the custom to classify under this rubric any large proportion of the deaths remotely due to alcohol, the fall in the rate could hardly have been so abrupt. On the other hand, it is well established that in earlier times ardent spirits were consumed with much greater constancy and liberality than in recent years. The partiality for strong drink of men connected with shipping is well-known, and the rise and fall in the mortality-rates from alcoholism in the period under review corresponds very closely with the growth and decline of the shipping trade.

PART VII.—MISCELLANEOUS CAUSES OF DEATH.

Chapter XVI.—Violence.

(Tables 120 to 123, graphs 30 to 32.)

For convenience, under this heading will be discussed deaths resulting directly or indirectly from man's acts. These may be divided into two general classes, accordingly as the actions are intentional or unintentional. Under the former class fall deaths from homicide and suicide, and to the latter class belong deaths in the broad sense accidentally caused by drowning, poison, fire, gases, weapons, falls, injuries by machines, vehicles, animals, and electricity. In either case, death may be the result of the intentional or of the unintentional acts of the victim himself or of other persons. It is to be recognized that to a very considerable degree the fatalities under both these categories are dependent upon a wide variety of conditions inherent in the circumstances in which the victims are situated in particular periods of life and of the city's history. Among the most important of these are age, occupation, location, and the character and degree of the moral, political, mechanical, industrial, and financial development. There can be little doubt that race stock has exerted a determining influence. In illustration, a few pertinent examples of the facts upon which these generalizations are based may be cited here. Homicides have been unusually frequent in times of political contention, and suicides have often increased in periods of financial depression and with the decrease in the proportion of negroes and the relative increase of certain other elements in the population. Drownings have become relatively fewer with the decline of the sailing ship and of the indulgence in aquatic sports with the gradual removal of the residential section from proximity to the water-front. The incidence as a cause of accidental death of burns, occurring very largely in young children, was influenced unfavorably by the use of open fire-places and coal-oil and gas stoves and favorably by the introduction of coal furnaces. Deaths from machinery accidents have varied with the extension of the use of machinery and perhaps with practical legislation. Fatalities from vehicular accidents have greatly increased with the growth of railway service, the introduction of electric power for street railways, and particularly of late years with the development of the automobile. Since a large proportion of the deaths classified under accidental falls and fractures occur in the aged, the relative number of deaths attributable to these causes is directly influenced by changes in the ratio of those of advanced age in the population.

Mortality data for this group as a whole and for homicide, suicide, drowning, and other accidents for the years 1812 to 1920, inclusive, are given in table 120, graph 30. It will be noted that deaths ascribed to starvation, to excess of heat and cold, and to lightning are not included. Though the rates often fluctuate considerably, not only from year to year, but from one period to another, this group as a whole has been continuously a major cause of death.

TABLE 120.—*Number of deaths and rate of death, per 100,000 living inhabitants, by violence, and the percentage of deaths by violence of total deaths from 1812 to 1920, inclusive.*

D = death. R = rate.

Year.	Homicides and suicides.						Accidents.						Total.		Percentage to total deaths.
	Homicides.		Suicides.		Total.		Drownings.		Other accidents.		Total.				
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	
1812	8	20	2	5	10	24	28	68	19	46	47	115	57	139	5
1813	1	2	1	2	2	5	27	63	31	72	58	136	60	140	5
1814	2	4	1	2	3	7	12	27	15	34	27	60	30	67	3
1815	2	4	4	9	6	13	23	49	22	47	45	96	51	109	4
1816	2	4	1	2	3	6	20	41	27	55	47	96	50	102	4
1817	3	6	5	10	8	16	38	75	36	71	74	145	82	161	6
1818	3	6	9	17	12	23	27	51	26	49	53	100	65	122	4
1819	7	13	3	5	10	18	31	56	19	34	50	90	60	108	3
1820	4	7	4	7	8	14	20	35	17	29	37	64	45	78	3
1821	6	10	2	3	8	13	30	50	33	55	63	104	71	118	4
1822	5	8	3	5	8	13	16	25	52	83	68	108	76	121	3
1823	5	8	5	8	10	15	41	63	29	44	70	107	80	122	4
1824	3	4	5	7	8	12	27	40	24	35	51	75	59	87	4
1825	4	6	7	10	11	16	26	37	14	20	40	56	51	72	4
1826	5	7	4	5	9	12	29	39	44	60	73	99	82	111	4
1827	8	10	4	5	12	16	26	34	29	38	55	72	67	87	5
1828	1	1	5	6	6	8	27	34	35	44	62	78	68	86	4
1829	2	2	9	11	11	13	38	46	41	50	79	96	90	109	5
1830	3	4	5	6	8	9	44	51	33	39	77	90	85	99	4
1831	...	...	6	7	6	7	29	33	44	50	73	82	79	89	4
1832	5	5	5	5	10	11	23	25	36	39	59	64	69	75	2
1833	8	8	7	7	15	16	28	29	40	42	68	71	83	87	4
1834	5	5	4	4	9	9	31	31	45	46	76	77	85	86	3
1835	4	4	4	4	8	8	29	28	40	39	69	67	77	75	4
1836	3	3	10	9	13	12	25	24	47	44	72	68	85	80	4
1837	11	10	5	5	16	15	39	36	41	37	80	73	96	88	4
1838	5	4	6	5	11	10	23	20	51	45	74	65	85	75	3
1839	2	2	3	3	5	4	35	30	38	32	73	62	78	67	3
1840	4	3	7	6	11	9	22	18	38	31	60	50	71	59	3
1841	5	4	3	2	8	6	64	51	38	30	102	82	110	88	5
1842	3	2	5	4	8	6	47	36	62	48	109	85	117	91	5
1843	7	5	1	1	8	6	24	18	35	26	59	44	67	50	3
1844	11	8	5	4	16	12	27	20	37	27	64	47	80	58	3
1845	6	4	6	4	12	8	34	24	53	37	87	61	99	70	3
1846	13	9	4	3	17	12	40	27	50	34	90	62	107	73	4
1847	8	5	3	2	11	7	34	23	48	32	82	55	93	62	3
1848	6	4	5	3	11	7	31	20	57	37	88	57	99	64	3
1849	5	3	4	3	9	6	25	16	52	33	77	48	86	54	2
1850	8	5	5	3	13	8	29	18	50	31	79	48	92	56	2
1851	7	4	6	4	13	8	46	27	64	38	110	65	123	73	3
1852	16	9	11	6	27	16	42	24	75	43	117	67	144	83	3
1853	4	2	1	1	5	3	52	29	110	62	162	91	167	94	3
1854	12	7	10	5	22	12	47	26	133	73	180	98	202	110	4
1855	14	7	13	7	27	14	50	27	90	48	140	74	167	89	3
1856	51	26	8	4	59	31	43	22	98	51	141	73	200	103	4
1857	33	17	4	2	37	19	40	20	92	46	132	66	169	85	3
1858	24	12	3	1	27	13	42	21	63	31	105	52	132	65	2
1859	18	9	9	4	27	13	35	17	76	36	111	53	138	66	3
1860	9	4	12	6	21	10	41	19	91	42	132	62	153	71	3
1861	15	7	10	5	25	11	33	15	96	44	129	59	154	70	3
1862	28	12	1	...	29	13	50	22	91	40	141	63	170	75	3
1863	19	8	6	3	25	11	55	24	99	43	154	67	179	77	3
1864	21	9	2	1	23	10	47	20	100	42	147	62	170	72	3
1865	9	4	5	2	14	6	52	21	83	34	135	56	149	61	3
1866	19	8	7	3	26	10	49	20	82	33	131	53	157	63	3

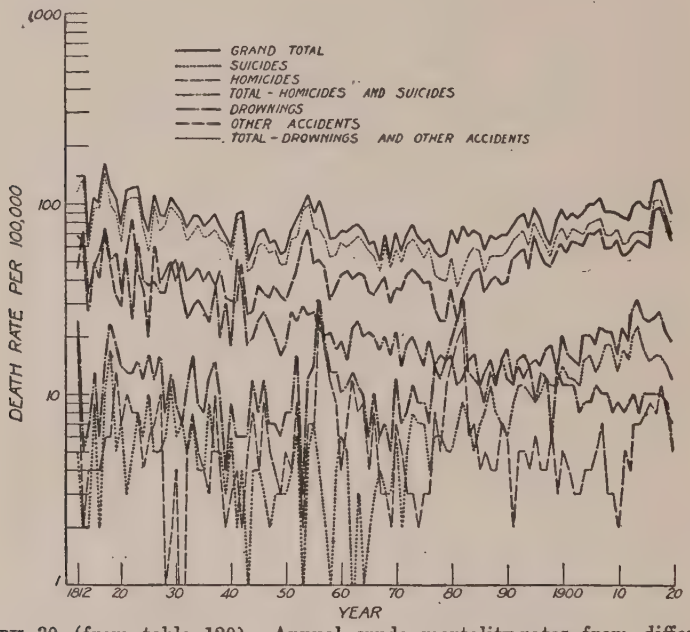
TABLE 120.—*Number of deaths and rate of death, per 100,000 living inhabitants, by violence, etc.*—Continued.

D = death. R = rate.

Year.	Homicides and suicides.						Accidents.						Total.		Percentage to total deaths.
	Homicides.		Suicides.		Total.		Drownings.		Other accidents.		Total.				
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	
1867	7	3	9	4	16	6	43	17	69	27	112	44	128	50	2
1868	9	3	9	3	18	7	52	20	106	41	158	61	176	68	3
1869	4	2	9	3	13	5	42	16	81	30	123	46	136	51	2
1870	18	7	16	6	34	12	58	21	97	36	155	57	189	69	3
1871	13	5	6	2	19	7	40	14	97	35	137	49	156	56	2
1872	8	3	15	5	23	8	52	18	120	42	172	60	195	68	2
1873	9	3	22	8	31	11	59	20	131	45	190	65	221	76	3
1874	6	2	20	7	26	9	50	17	124	42	174	58	200	67	3
1875	8	3	20	7	28	9	42	14	115	38	157	51	185	61	3
1876	8	3	13	4	21	7	59	19	121	39	180	58	201	65	3
1877	27	8	18	6	45	14	44	14	90	28	134	42	179	56	2
1878	17	5	21	6	38	12	52	16	78	24	130	40	168	52	3
1879	35	11	15	5	50	15	51	15	78	24	129	39	179	54	2
1880	47	14	18	5	65	19	54	16	120	35	174	51	239	71	3
1881	65	19	23	7	88	25	39	11	84	24	123	36	211	61	2
1882	79	22	30	9	109	31	42	12	114	32	156	44	265	75	3
1883	20	6	26	7	46	13	55	15	135	38	190	53	236	66	3
1884	25	7	20	5	45	12	58	16	156	43	214	58	259	71	3
1885	15	4	28	7	43	11	42	11	169	45	211	56	254	68	3
1886	19	5	31	8	50	13	36	9	129	34	165	43	215	56	3
1887	15	4	43	11	58	15	50	13	152	39	202	52	260	67	3
1888	15	4	35	8	50	12	45	11	172	41	217	52	267	64	3
1889	30	7	32	7	62	15	62	15	160	37	222	52	284	67	3
1890	27	6	25	6	52	12	73	17	166	38	239	55	291	67	3
1891	10	2	39	9	49	11	51	12	222	50	273	62	322	73	3
1892	21	5	48	11	69	15	61	14	239	53	300	67	369	82	3
1893	22	5	50	11	72	16	57	12	262	57	319	79	391	86	4
1894	18	4	48	10	66	14	66	14	207	45	273	59	339	73	4
1895	26	6	43	9	69	15	44	9	324	69	368	78	437	93	4
1896	20	4	48	10	68	14	60	13	261	55	321	67	389	81	4
1897	21	4	60	12	81	17	56	12	231	48	287	59	368	76	4
1898	32	6	56	11	88	18	31	6	226	46	257	52	345	70	3
1899	13	3	54	11	67	13	63	13	265	53	328	66	395	79	4
1900	27	5	72	14	99	20	57	11	311	61	368	73	467	92	4
1901	22	4	61	12	83	16	56	11	275	54	331	64	414	81	4
1902	16	3	60	12	76	15	56	11	326	63	382	73	458	88	4
1903	14	3	58	11	72	14	44	8	324	61	368	70	440	83	4
1904	24	4	81	15	105	20	47	9	313	59	362	68	467	87	4
1905	19	4	88	16	107	20	47	9	371	69	418	77	525	97	5
1906	26	5	70	13	96	18	61	11	372	68	433	79	529	97	5
1907	41	7	83	15	124	22	54	10	396	72	450	81	574	104	5
1908	19	3	98	18	117	21	55	10	319	57	374	67	491	88	5
1909	18	3	101	18	119	21	47	8	335	59	382	67	501	88	5
1910	14	2	77	13	91	16	49	9	358	63	407	71	498	87	5
1911	27	5	100	17	127	22	45	8	302	52	347	60	474	82	5
1912	22	4	88	15	110	19	52	9	313	54	365	62	475	81	5
1913	41	7	118	20	159	27	58	10	349	59	407	69	566	96	6
1914	44	7	138	23	182	31	46	8	373	63	419	70	601	101	6
1915	48	8	101	17	149	25	58	10	360	60	418	70	567	94	6
1916	53	9	94	15	147	24	59	10	352	58	411	68	558	92	5
1917	52	8	100	16	152	25	64	10	560	91	624	102	776	127	7
1918	65	11	101	16	166	27	60	10	575	93	635	103	801	130	5
1919	57	8	98	14	155	21	64	9	544	75	608	84	763	106	7
1920	52	7	88	12	140	19	37	5	465	63	502	68	642	87	6

The total rate declined from 139 in 1812 to 50 in 1843. Gradually rising again to 110 by 1854, it slowly receded to 50 in 1867. From this date, though with wavering steps, the rate gradually rose to 130 in 1918. By 1920 it had fallen to 87.

For homicide, the annual rates have varied within wide limits, the extremes being zero in 1831 and 26 in 1856. While relatively high and low annual rates often alternated, a decided tendency to epidemic waves covering periods of years is evident. Conspicuous in this regard are the periods 1818–1821, 1854–1859, 1879–1882, 1913–1920. The high rates (20) attained in 1812 and in certain years of the fifth, sixth, and ninth decades of the nineteenth century occurred in times of intense political rivalry, which were often characterized by feuds and riots.



GRAPH 30 (from table 120). Annual crude mortality-rates from different types of violence, from 1812 to 1920, inclusive.

For suicides, the fluctuation in the rates from year to year, especially in the period prior to 1880, was even more marked than for homicide. The extremes were rates of 1 in 1843, 1853, 1858, and 1864, and of 17 in 1818 for the early years, and of 23 in 1914 for the later years. It will be noted that the rates, which were low in 1812 to 1814, rose after the close of the war in 1815 and maintained a comparatively high level for over 15 years. After this period the course of the rates was very irregular, but, on the whole, relatively low until after 1870. During the Civil War the rates were conspicuously low. After 1880 the rates gradually rose and the annual fluctuations became much less marked. From the peak-rate of 23 attained in 1914, the rate receded during the period of the World War and by 1920 had fallen 50 per cent to 12, the lowest rate since 1903. From a special table in the annual report for 1892,

giving the annual number of deaths from suicide from 1875 to 1892, inclusive, it appears that the total of 489 suicides were distributed by sex and color as follows: White males, 394; white females, 87; colored males, 5; and colored females, 3. Accidental drowning, until 1830 a serious rival of all other accidents as a cause of death, gradually declined from peak-rate of 75 in 1817 to the relatively inconsiderable rate of 5 in 1920. While the course of the rates was subject to fluctuations from year to year and over longer periods, it is, on the whole, comparatively regular.

The rates for deaths from all other accidents have varied within wide limits, from 20 in 1825 to 93 in 1918. Though subject to marked variations in level, in general the course of the rates between 1812 and 1843 was downward. A succession of three rather smoothly outlined waves occurred between 1844 and 1878. The course of the rates since 1881 is marked by a long upward sweep, broken here and there by crests and depressions, to 93 in 1918, and with a

TABLE 121.—*Absolute figures of deaths by accident, except drowning, for the years 1900, 1905, 1910, 1915, and 1920.*

Causes of death.	1900	1905	1910	1915	1920
Poisoning by food. (164)	....	....	1	4	8
Other acute poisonings. (165)	9	20	8	6	9
Conflagration. (166)	13	77	6	5	9
Burns. (167)	....	....	80	70	81
Deleterious gases. (168)	16	14	16	10	28
Traumatism by firearms. (170)	9	9	7	2	6
Traumatism by cutting and piercing instruments. (171)	....	....	1	1	1
Traumatism by fall. (172)	7	37	80	81	109
Traumatism in mines and quarries. (173)	....	....	1	....	1
Traumatism by machines. (174)	....	....	15	5	22
Traumatism by crushing. (Vehicles, etc.) (175)	72	88	93	76	161
Traumatism by animals. (176)	....	....	2	2	2
Traumatism by electricity. (Lightning excepted.)	3	6	9	....	8
Fractures. (Cause not specified.) (185)	73	63	7	2	....
Other external violence. (186)	59	57	30	12	20
Total	254	314	366	276	465

recession to 63 in 1920. The unusually high rates for 1917 and 1918 were associated with a considerable increase of accidents in connection with the feverish war activities. For example, in 1918, the number of deaths from machinery, falls, vehicles, and "other external violence" exceeded that for 1920 by 110, or 24 per cent.

From table 121, in which are given the absolute figures for the main categories of accidents except drowning for the years 1900, 1905, 1910, 1915, and 1920, a very good idea is gained of the relative lethal importance of the various types of accidents. Owing to modifications in the official classification, the rubrics poisoning, burns, falls, and other external violence in 1900 and 1905 are not strictly comparable with those in the later years. The predominant importance of deaths due to burns, falls (with fractures due to falls), and vehicles is clear. The increase in the number of deaths under the latter rubric was due to automobiles. The small part played by machinery indicates that the death-toll paid directly to manufacturing is relatively light.

The influence of age and color upon accidental death in an average year is illustrated in table 122. The high proportion of negroes and of non-residents is striking. The large proportion of the deaths attributed to falls in individuals over the sixty-fifth year indicates the conspicuous part played by falls resulting in fractures followed by death in the aged. Nearly half the vehicular deaths were caused by injuries from automobiles and a strikingly large share of all deaths from vehicular accidents occurred in non-residents, most of whom were brought to the city for surgical care after injury.

From the rates averaged for 5-year periods (table 123, graph 31), it is evident that the chance of a violent end of life in 1915–1920 was nearly as good as it was in 1812–1815. Drowning is the only one of this group of causes of death that has shown any decrease in rate. Homicide holds its own, and

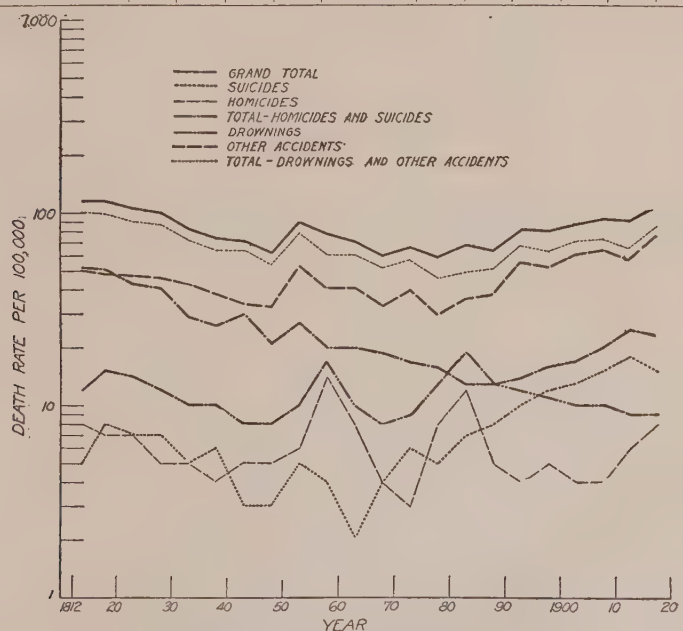
TABLE 122.—*Influence of age and color upon the absolute number of deaths by accident for 1917.*

	Poisoning.	Burns, conflagrations.	Burns and scalds.	Asphyxia, acid.	Gas from oil stove.	Illuminating gas.	Suffocation in bed.	Drowning.	Firearms.	Cutting instruments.	Falls.	Machinery.	Elevators.	Automobiles.	Street cars.	Steam railroads.	Other vehicles.	Landslides.
Total	16	13	78	1	4	18	5	64	9	1	115	13	7	76	47	27	15	2
White	11	11	50	..	4	18	3	42	8	1	102	8	2	68	34	20	13	1
Colored	5	2	28	1	..	..	2	22	1	..	13	5	5	8	13	7	2	1
Non-residents	..	4	11	..	..	..	..	8	6	..	17	3	7	21	10	9	4	..
Under 1 year	..	2	3	..	..	..	5	..	..	..	..	..	..	..	..	..	..	..
Between 1 and 2 yrs.	1	1	6	..	1	..	..	..	..	..	2	..	..	1	..	..	..	..
2 to 4 years	3	..	23	..	2	..	..	..	..	..	6	..	..	8	3	..	..	..
5 to 14 years	1	..	16	..	..	..	..	12	1	..	5	..	1	26	7	1	3	..
15 to 24 years	1	1	5	..	..	..	..	8	4	..	6	4	2	9	7	3	..	..
25 to 44 years	5	5	8	..	1	4	..	28	4	..	18	2	3	14	13	13	8	1
45 to 65 years	5	1	12	1	..	10	..	14	..	..	31	7	1	13	14	10	3	1
66 years and over	..	3	5	..	..	4	..	2	..	1	47	..	..	5	3	..	1	..

suicides and accidents other than drowning have actually increased. The rate for suicide has indeed multiplied three times. The course of the curves for homicide and suicide suggests the possibility that to some degree the ultimate motives underlying these acts are interrelated. It will be noted that when the rates for one are high, those for the other are commonly low. The curve of the rates for deaths from intentional violence—homicides and suicides taken together—shows a very distinct rise over the 109 years under review, and is marked by four definite peaks, of which each of the last three is higher than its predecessor. These peaks fall in the 5-year periods 1815–1820, 1856–1860, 1881–1885, and 1911–1915, and are therefore separated by periods of about 30 years. The curve for the rates for unintentional violence—all accidental deaths—falls rather regularly on the whole between 1812–1815 and 1876–1880, and then ascending steadily throughout the rest of its course, and in spite of the constantly decreasing importance of drowning, ends at a level of only 20 per cent less than at the beginning. As judged by rates averaged

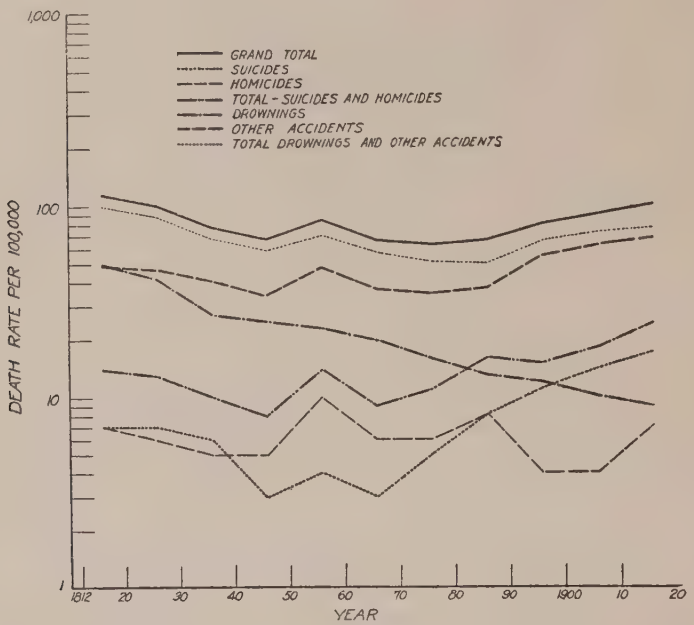
TABLE 123.—*Average rate of death, per 100,000 living inhabitants, by 5- and 10-year periods from violence, from 1812 to 1920, inclusive.*

Periods.	Homicides and suicides.						Accidents.						Total.	
	Homicides.		Suicides.		Total.		Drownings.		Other accidents.		Total.			
	By 5-year periods.	By10-year periods.	By 5-year periods.	By10-year periods.	By 5-year periods.	By10-year periods.	By 5-year periods.	By10-year periods.	By 5-year periods.	By10-year periods.	By 5-year periods.	By10-year periods.	By 5-year periods.	By10-year periods.
1812-15	8	...	5	...	12	...	52	...	50	...	102	...	114	...
1816-20	7	7	8	7	15	14	51	50	48	49	99	100	114	114
1821-25	7	...	7	...	14	...	43	...	47	...	90	...	104	...
1826-30	5	6	7	7	12	13	41	42	46	47	87	89	99	101
1831-35	5	...	5	...	10	...	29	...	43	...	72	...	82	...
1836-40	4	5	6	6	10	10	26	27	38	41	64	68	74	78
1841-45	5	...	3	...	8	...	30	...	34	...	64	...	71	...
1846-50	5	5	3	3	8	8	21	25	33	34	54	59	62	67
1851-55	6	...	5	...	10	...	27	...	53	...	79	...	90	...
1856-60	14	10	4	4	17	14	20	23	41	47	61	70	78	84
1861-65	8	...	2	...	10	...	20	...	41	...	61	...	71	...
1866-70	4	6	4	3	8	9	19	20	33	37	52	57	60	66
1871-75	3	...	6	...	9	...	17	...	40	...	57	...	66	...
1876-80	8	6	5	5	13	11	16	16	30	35	46	51	59	63
1881-85	12	...	7	...	19	...	13	...	36	...	49	...	68	...
1886-90	5	8	8	8	13	16	13	13	38	37	51	50	64	66
1891-95	4	...	10	...	14	...	12	...	55	...	67	...	81	...
1896-1900	5	4	12	11	16	15	11	12	52	54	63	65	80	80
1901-05	4	...	13	...	17	...	10	...	61	...	71	...	87	...
1906-10	4	4	15	14	20	18	10	10	64	62	73	72	93	90
1911-15	6	...	18	...	25	...	9	...	57	...	66	...	91	...
1916-20	8	7	15	17	23	24	9	9	76	67	85	76	108	100



GRAPH 31 (from table 123). Crude mortality-rates from different types of violence, averaged by 5-year periods, from 1812 to 1920, inclusive.

for 5-year periods, between 1812 and 1920, the mortality for intentional violence increased by 100 per cent, the mortality for unintentional violence decreased by 20 per cent, and for all forms of violence there was a decrease in mortality of only 5.5 per cent.



GRAPH 32 (from table 123). Crude mortality-rates from different types of violence, averaged by 10-year periods, from 1812 to 1920, inclusive.

Chapter XVII.—Child-Birth.

(Tables 124 to 127, graphs 33 to 34.)

Deaths from this group of causes were recorded under the single rubric, "childbed," until 1875, when those from puerperal fever were classified under a new rubric of that title. Since the adoption of the international classification in 1899, deaths of women from causes connected with child-birth have been classified under the eight rubrics, 134 to 141, of this statistical nosology. From the relatively small number of deaths ascribed to childbed in the earlier years, it is perhaps fair to assume that the assignments of deaths under this rubric was specific, that is, restricted to deaths of mothers due to causes connected with giving birth to children, and did not include deaths of lying-in women from general causes. Indeed, it is not unlikely that the term was used in a narrower sense than is now the custom, to embrace only deaths of women from causes immediately connected with giving birth to children, living or still, of viable age.

In the discussion of natality it has been made clear that before 1915 births were not reported with sufficient accuracy for the calculation on this basis of reliable rates of maternal risks in child-bearing. Nor, owing to the uncertainties connected with estimating in this heterogeneous population from year to year over so long a period, the number of women of the usual child-bearing age (15 to 50 years), is it practicable to calculate rates on the basis next in order of specificity. Consequently, for the years 1812 to 1914, inclusive, maternal mortality from child-bearing must be measured either in terms of the female or of the whole population. Rates calculated on these bases are given in table 124, graph 33. The following discussion of the puerperal mortality will be confined to the former. It will be observed that these rates often vary not only from year to year, but over long series of years. Rates over 100 obtained in years so widely separated as 1816 and 1872. Rates over 80 prevailed in a number of years. As the other extreme, rates under 35 occurred in both early and recent years, in some years of the third, fourth, fifth, sixth, seventh, and tenth decades of the nineteenth century, and frequently after 1900. Fluctuations from very high to very low rates, and vice versa, did not occur during short periods of 2 or 3 years, but the transition to opposite levels was usually gradual.

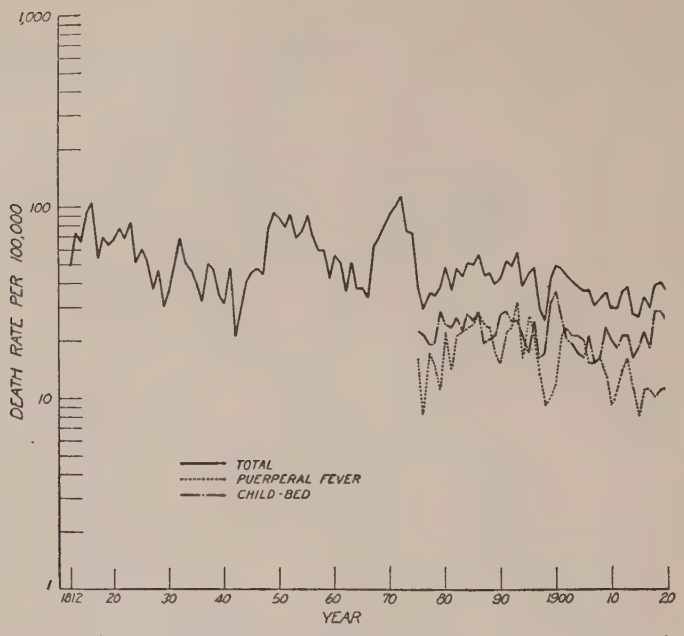
Taking as a convenient basis of comparison the rates averaged for 5-year periods (table 125, graph 34), several distinct waves of high mortality are evident. After remaining on a level of about 70 from 1812 to 1825, during the next 5 years the averaged rate declined to 40. Following a slight reaction to 51 between 1831 and 1835, the rate declined for 10 years and reached the comparatively low level of 37 during the 5 years ending in 1845. Rebounding to 69 during the next quinquennium, the rate attained 80 between 1851–1855. Another abrupt decline brought the rate to 43 in the period ending in 1865. This wave was immediately succeeded by a second of very similar proportions, with a peak-rate of 79 between 1871 and 1875 and with a decline to 37 in the next 5-year period. The fluctuations were comparatively slight between 1881

TABLE 124.—*Number of deaths and rate of death, per 100,000 living inhabitants and 100,000 living female inhabitants, from causes connected with child-birth, from 1812 to 1920, inclusive.*

Year.	Child-bed.			Puerperal fever.			Total.		
	Deaths.	Rate per 100,000 total population.	Rate per 100,000 female population.	Deaths.	Rate per 100,000 total population.	Rate per 100,000 female population.	Deaths.	Rate per 100,000 total population.	Rate per 100,000 female population.
1812	..	..	..	..	..	..	10	26	49
1813	..	..	..	..	..	..	16	37	74
1814	..	..	..	..	..	..	15	34	66
1815	..	..	..	..	..	..	22	47	93
1816	..	..	..	..	..	..	26	53	104
1817	..	..	..	..	..	..	14	27	54
1818	..	..	..	..	..	..	19	36	70
1819	..	..	..	..	..	..	18	32	63
1820	..	..	..	..	..	..	20	35	67
1821	..	..	..	..	..	..	24	40	77
1822	..	..	..	..	..	..	22	35	68
1823	..	..	..	..	..	..	28	43	82
1824	..	..	..	(2)	(3)	..	18	26	51
1825	..	..	..	..	..	..	22	31	60
1826	..	..	..	..	..	..	20	27	52
1827	..	..	..	..	..	..	15	20	37
1828	..	..	..	..	..	..	19	24	46
1829	..	..	..	..	..	..	13	16	30
1830	..	..	..	..	..	..	16	19	36
1831	..	..	..	..	..	..	24	27	51
1832	..	..	..	..	..	..	33	36	68
1833	..	..	..	..	..	..	25	26	50
1834	..	..	..	..	..	..	24	24	46
1835	..	..	..	..	..	..	21	21	39
1836	..	..	..	..	..	..	18	17	32
1837	..	..	..	..	..	..	29	26	50
1838	..	..	..	..	..	..	28	25	47
1839	..	..	..	..	..	..	21	18	34
1840	..	..	..	..	..	..	20	17	31
1841	..	..	..	..	..	..	31	25	47
1842	..	..	..	..	..	..	14	11	21
1843	..	..	..	..	..	..	21	16	30
1844	..	..	..	..	..	..	29	21	40
1845	..	..	..	..	..	..	34	24	45
1846	..	..	..	..	..	..	36	25	47
1847	..	..	..	..	..	..	35	23	44
1848	..	..	..	..	..	..	62	40	76
1849	..	..	..	..	..	..	78	49	93
1850	..	..	..	..	..	..	75	46	87
1851	..	..	..	..	..	..	70	42	78
1852	..	..	..	..	..	..	83	48	91
1853	..	..	..	..	..	..	65	36	69
1854	..	..	..	..	..	..	71	39	73
1855	..	..	..	..	..	..	90	48	90
1856	..	..	..	..	..	..	72	37	70
1857	..	..	..	..	..	..	62	31	59
1858	..	..	..	..	..	..	63	31	59
1859	..	..	..	..	..	..	46	22	42
1860	..	..	..	..	..	..	64	30	56
1861	..	..	..	..	..	..	59	27	51
1862	..	..	..	..	..	..	43	19	36
1863	..	..	..	..	..	..	64	28	52
1864	..	..	..	..	..	..	46	19	37
1865	..	..	..	..	..	..	47	19	37
1866	..	..	..	..	..	..	43	17	33

TABLE 124.—*Number of deaths and rate of death, per 100,000 living inhabitants, etc.*—Continued.

Year.	Child-bed.			Puerperal fever.			Total.		
	Deaths.	Rate per 100,000 total population.	Rate per 100,000 female population.	Deaths.	Rate per 100,000 total population.	Rate per 100,000 female population.	Deaths.	Rate per 100,000 total population.	Rate per 100,000 female population.
1867	..	..	..	..	..	..	84	33	63
1868	..	..	..	..	..	..	94	36	68
1869	..	..	..	..	..	..	113	42	80
1870	..	..	..	..	..	..	129	47	90
1871	..	..	..	..	..	..	146	52	99
1872	..	..	..	..	..	..	166	58	111
1873	..	..	..	..	..	..	113	39	74
1874	..	..	..	..	..	..	113	38	72
1875	35	8	22	25	6	16	60	14	37
1876	35	11	21	13	4	8	48	15	29
1877	31	10	19	28	9	17	59	19	35
1878	32	10	19	26	8	15	58	18	34
1879	48	14	28	19	6	11	67	20	38
1880	43	13	24	40	12	22	83	25	47
1881	41	12	23	25	7	14	66	19	36
1882	49	14	26	38	11	21	87	25	47
1883	41	11	22	41	11	22	82	23	43
1884	52	14	27	44	12	23	96	26	50
1885	49	13	25	48	13	24	97	26	49
1886	56	15	28	55	14	27	111	29	55
1887	42	11	19	53	14	24	95	24	43
1888	45	11	20	52	12	23	97	23	44
1889	48	11	21	39	9	17	87	20	39
1890	62	14	27	34	8	15	96	22	42
1891	66	15	28	52	12	22	118	27	51
1892	60	13	25	54	12	23	114	25	48
1893	60	13	25	78	17	32	138	30	57
1894	52	11	21	40	9	16	92	20	38
1895	43	9	17	66	14	27	109	23	44
1896	63	13	25	54	11	22	117	24	47
1897	41	8	16	34	7	13	75	15	29
1898	43	9	17	22	4	9	65	13	25
1899	81	16	31	27	5	10	108	22	41
1900	95	19	36	31	6	12	126	25	48
1901	71	14	27	55	11	21	126	25	47
1902	55	11	20	62	12	23	117	22	43
1903	53	10	19	58	11	21	111	21	40
1904	47	9	17	59	11	21	106	20	38
1905	46	9	16	56	10	20	102	19	36
1906	59	11	21	43	8	15	102	19	36
1907	44	8	15	43	8	15	87	16	30
1908	47	8	16	45	8	16	92	16	32
1909	66	12	23	37	7	13	103	18	35
1910	59	10	20	27	5	9	86	15	29
1911	54	9	18	33	6	11	87	15	29
1912	62	11	21	43	7	14	105	18	35
1913	63	11	21	49	8	16	112	19	37
1914	49	8	16	35	6	11	84	14	27
1915	55	9	18	25	4	8	80	13	26
1916	69	11	22	35	6	11	104	17	33
1917	57	9	18	34	6	11	91	15	29
1918	88	14	28	31	5	10	119	19	38
1919	103	14	28	40	6	11	143	20	39
1920	93	13	25	40	5	11	133	18	36



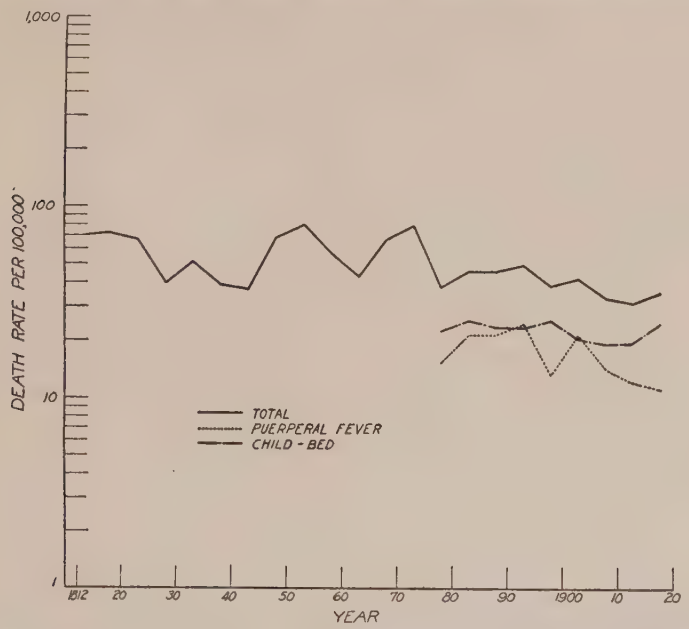
GRAPH 33 (from table 124). Mortality-rates, per 100,000 living female inhabitants, from causes connected with child-birth, from 1812 to 1920, inclusive.

TABLE 125.—*Average rate of death, per 100,000 living inhabitants and per 100,000 living female inhabitants, by 5-year periods, from causes connected with child-birth, from 1812 to 1920, inclusive.*

Periods.	Child-bed.		Puerperal fever.		Total.	
	Total population.	Female population.	Total population.	Female population.	Total population.	Female population.
1812-15	..	..	..	..	36	70
1816-20	..	..	..	..	37	72
1821-25	..	..	..	..	35	67
1826-30	..	..	..	..	21	40
1831-35	..	..	..	..	27	51
1836-40	..	..	..	..	21	39
1841-45	..	..	..	..	19	37
1846-50	..	..	..	..	27	69
1851-55	..	..	..	..	42	80
1856-60	..	..	..	..	30	57
1861-65	..	..	..	..	22	43
1866-70	..	..	..	..	35	67
1871-75	..	..	..	..	39	79
1876-80	12	22	8	15	19	37
1881-85	13	25	11	21	24	45
1886-90	12	23	11	21	24	45
1891-95	12	23	13	24	25	48
1896-1900	13	25	7	13	20	38
1901-05	10	20	11	21	21	41
1906-10	10	19	7	14	17	33
1911-15	10	19	6	12	16	31
1916-20	12	24	5	11	18	35

and 1905. During the remainder of the period the rate was 33 from 1906 to 1910, 31 from 1911 to 1915, and 35 from 1916 to 1920. The two high waves which occurred between 1846 and 1880 culminated with a rate on a level with that which obtained in 1841–1845 and which was not bettered in any subsequent period until 1906–1910.

Rates for puerperal fever and for all other causes combined, for which separate data exist since 1875 (tables 124 and 125, graphs 33 and 34), run quite different courses. As averaged for 5-year periods the rate for other causes of maternal deaths follows a fairly even course. During the whole term this rate varied only between 25 and 19 and the level was nearly the same in the first and the last 5-year periods. In strong contrast with this com-



GRAPH 34 (from table 125). Mortality-rates, per 100,000 living female inhabitants, from causes connected with child-birth, averaged by 5-year periods, from 1812 to 1920, inclusive.

parative stability, the rate for puerperal fever varied from 15 in 1875–1880 and 24 in 1891–1895 to 11 in 1916–1920.

There were two very distinct high waves of mortality, one between 1876 and 1895 and the other between 1901 and 1905. From the last peak which was attained in the period 1901–1905, the rate declined continuously, and in the period 1916–1920 it stood at its lowest recorded level. These two considerable waves of high mortality from puerperal fever correspond with similar though relatively slight changes in the total rate. In so far as may be judged from rates so crude, this picture suggests that puerperal fever, like other infectious diseases, has run in epidemic course and that this affection was the chief factor in the earlier high waves of total child-bed mortality.

It has been recently pointed out by the writer (66) that annual rates calculated from the sum of the recorded living and still-births and the number

of deaths of women classified under affections of the puerperal state (rubrics 134 to 141, inclusive) express in terms more nearly specific than those commonly relied on the actual risk of death of women definitely exposed in child-bearing. Expressed in formal terms the true maternal risk-rate in child-bearing is derived from the formula

$$RP = \frac{DP}{BL + BS}$$

where DP equals the number of maternal deaths due to causes definitely connected with the puerperal state and BL and BS equal the number of live and still-births, respectively. It was recognized that, while far more accurate than those in common use, owing to certain defects in the divisor connected with the definition of still-births and in the dividend resulting from errors in the nosological classification of maternal deaths, even this method cannot be expected in actual practice to measure with absolute accuracy the risk to mothers in child-bearing, nor to yield figures which for different places are strictly comparable.

The term *still-birth* is variously defined in different countries and in different localities in the same country, from early embryos to full-term children born alive, but not surviving the third day of extra-uterine life. The mean between those extremes, in most countries at least, is represented by a dead-born fetus of that age-period of utero-gestation at which, if liveborn, extra-uterine existence is possible, or, in other words, a dead-born fetus past the sixth month after conception. After consideration of available data, the conclusion was reached that in 1918 for the United States birth registration area as a whole, the number of still-births reported represented the actual number of fetuses of 5 months and over of utero-gestation born dead. It was found that for this year in the United States registration area the proportion of instances of plural to single births was approximately 1 per cent. As the reporting of live births is complete nowhere in the United States, it was thought inadvisable in general studies based on the natality figures of this country to apply this obvious correction. The inclusion of still-births in the divisor is demanded on medical as well as on statistical grounds, for many of the factors which cause the death of the unborn child, or which accompany or follow birth of a still-born child, actually increase the maternal risks.

The dividend, which embraces the deaths classified under rubrics 134 to 141, inclusive, is open to certain obvious, but usually overlooked, errors. While these rubrics are specific in the sense that they do not include deaths occurring in pregnant women due to ordinary causes, such as communicable diseases (puerperal infection excepted) and cardio-renal disease, for instance, some of them are not specific for the present purpose. To six of the eight rubrics, accidents of pregnancy (134), puerperal hemorrhage (135), accidents of labor (136), puerperal septicemia (137), puerperal albuminuria and convulsions (138), and phlegmasia and alba dolens (139), are credited some deaths of women from these causes occurring in all stages of the pregnant and puerperal states from conception to weeks after the completion of labor. Accidents of pregnancy include maternal deaths due to accidental abortions, miscarriages, extra-uterine pregnancy, and vomiting of pregnancy occurring in the early months of gestation. Puerperal hemorrhage, toxemias, and convulsions, puer-

peral infection (after abortions and miscarriages), deformities of mother or child, injuries and operations, and any of the vascular lesions enumerated under rubric 139, may be fatal before the end of the fifth month of pregnancy.

All except two and all the important rubrics include some maternal deaths occurring at any time during the pregnant state, and therefore represent not with strict accuracy but only approximately the number of deaths from these causes of women 5 months pregnant and over. These rubrics were set up on the principle of measuring the deaths of the whole pregnant state. On the other hand, by the consensus of opinion, child-birth, or labor, has been restricted to the act of bringing into the extra-uterine world fetuses of at least 5 months of utero-gestation. Therefore, to obtain maternal risk-rates strictly specific for the act of child-birth, where the divisor consists of the total number of living and still-born children above this arbitrarily fixed stage of development, the dividend should include only those maternal deaths which occur in connection with the borning of children after the completion of the fifth month of pregnancy. To determine the risk of death to women of becoming pregnant, that is, from conception to several weeks after expulsion of the living or dead impregnated ovum of whatever period of development, is impossible. The number of deaths under these eight rubrics under discussion furnish the dividend, but there are lacking the correct figures for the divisor, which embrace not only the births of fetuses over the fifth month of gestation, but the large and entirely unknown number of miscarriages and of recognized and unrecognized abortions.

It is evident, then, that from the recorded data it is impossible to calculate with absolute accuracy the risk to women of either pregnancy or of child-birth. For determining the risk of death in child-birth there are in both divisor and dividend certain relatively minor errors for which, under methods by which the data are collected and recorded, fitting allowances for correction can not be made. It is clear, however, that the method here employed must measure much more accurately than any of those in general use the risk to women of dying from causes connected with child-birth.

For the 6-year period 1915 to 1920, the living and still-births have been reported with sufficient accuracy for the calculation on the basis above outlined of specific maternal risk-rates of deaths connected with child-birth. The data are presented in table 126. Considering first the total population, that is, whites and negroes together, it will be noticed that the rate for all causes in the puerperal state not only reached the very high average level of 646, but actually rose during the period under consideration from 542 in 1915 to 659 in 1920, with even higher rates in 1918 and 1919. Puerperal infection, with an average rate of 197, was responsible for 30 per cent of the deaths from this group of causes. Puerperal albuminuria and convulsions ranked next and rose to a level almost as high. The rates for accidents of pregnancy varied considerably from year to year, and with an average rate of 101 and average percentage of the whole number of deaths of 15.8, stood third in order of fatality. Puerperal hemorrhage and accidents of labor, which also showed marked annual fluctuations with averaged rates of 75 and 67, respectively, were of about equal lethal force. No deaths were ascribed to rubrics 140 and 141. The fatality of the puerperal affections in whites and in negroes may be compared for 1919 and 1920. Taking the average for the two years it is to be

TABLE 126.—*Number of deaths and rate of death, per 100,000 births, living and still, from causes connected with the puerperal state and the percentage contributed by each rubric to the whole number of such deaths, together with the percentage of still-births to total births, from 1915 to 1920, inclusive. Corresponding data for white and colored for 1919 and 1920 are appended.**

D = death. R = rate.

Year.	Births.				134 Accidents of pregnancy.			135 Puerperal hemorrhage			136 Other accidents of labor.			138 Puerperal albuminuria and convulsions.			139 Puerperal phlegmasia, alba dolens, embolus, sudden death.			Total puerperal state excluding puerperal septicemia.			137 Puerperal septicemia.			Total puerperal state.	
	Total.	Living.	Still.	Per cent of still to totals	D	R	Per cent of total puerperal state.	D	R	Per cent of total puerperal state.	D	R	Per cent of total puerperal state.	D	R	Per cent of total puerperal state.	D	R	Per cent of total puerperal state.	D	R	Per cent of total puerperal state.	D	R	Per cent of total puerperal state.	D	R
1915	14765	13634	1131	7.7	11	75	13.8	10	68	12.5	6	41	7.5	22	149	27.5	6	41	7.5	55	373	68.8	25	169	31.2	80	542
1916	16320	15085	1235	7.6	17	104	16.4	12	74	11.5	8	49	7.7	28	171	26.9	4	25	3.9	69	423	66.4	35	215	33.7	104	637
1917	16217	14950	1267	7.8	8	49	8.8	11	68	12.1	7	43	7.7	31	191	34.1	2	12	2.2	59	364	64.8	32	197	35.2	91	561
1918	16492	15292	1200	7.3	30	182	25.2	12	73	10.0	14	85	11.8	31	188	26.1	1	6	0.8	88	534	74.0	31	188	26.1	119	722
1919	18958	17631	1327	7.0	21	111	14.7	19	100	13.3	21	111	14.7	38	200	26.6	4	21	2.8	103	543	72.0	40	211	28.0	143	754
1920	20185	18787	1398	6.9	19	94	14.3	13	64	9.8	15	74	11.3	42	208	31.6	4	20	3.0	93	461	69.9	40	198	30.1	133	659
Total	101539	93981	7558	7.4	106	101	15.8	77	75	11.5	71	67	10.6	192	185	28.7	21	21	3.1	467	449	69.7	203	197	30.3	670	646
1919																											
White	15841	14908	933	5.9	18	114	16.7	15	95	13.9	16	101	14.8	27	170	25.0	4	25	3.7	80	505	74.1	28	177	25.9	108	682
Colored	3117	2723	394	12.6	3	96	8.6	4	128	11.4	5	160	14.3	11	353	31.4	..	..	...	23	738	65.7	12	385	34.3	35	1123
1920																											
White	16909	15934	975	5.8	17	101	16.8	10	59	9.9	13	77	12.9	32	189	31.7	3	18	2.9	75	444	74.3	26	154	25.7	101	597
Colored	3276	2853	423	12.9	2	61	6.3	3	92	9.4	2	61	6.3	10	305	31.3	1	31	3.1	18	549	56.3	14	427	43.8	32	977
Total white	32750	30842	1908	5.9	35	108	16.7	25	77	12.0	29	89	13.9	59	180	28.2	7	22	3.3	155	475	74.2	54	166	25.8	209	640
Total colored	6393	5576	817	12.8	5	79	7.5	7	110	10.4	7	111	10.4	21	329	31.3	1	16	1.5	41	644	61.2	26	406	38.8	67	1050

* Since no deaths were recorded under the headings "Following Child-birth," and "Puerperal diseases of the breast," these two rubrics (Nos. 140 and 141) are omitted from the table.

observed that the rate in negroes for the whole puerperal state was nearly double and for puerperal fever more than double those for whites. The rates were considerably higher in negro than in white women for every rubric under which deaths were recorded, with the exception of those for accidents of pregnancy and vascular affections. The importance of taking still-births into account in calculating puerperal risk-rates is very obvious from this table. Were they omitted, the divisors would be too small for the population as a whole by 7.4 per cent and for white and for negro women by 5.9 and 12.8 per cent, respectively, with corresponding errors in the resulting rates.

During the 6-year period 1915–1920, of 101,539 conceptions that developed to or beyond the sixth month of utero-gestation, 7,558, or 7.4 per cent, were blighted, and of approximately the same number of women exposed under the same conditions to the risks of maternity there died 670 or 0.65 per hundred. This combination of appallingly high rates of both maternal and fetal mortality has been equaled perhaps in modern times in no other medical center. In the United States birth registration area in 1918 and in Boston in recent years, the maternal death-rates were considerably higher, but they were associated with still-birth rates not half so high (Howard, 66).

Having determined the approximately true maternal risk of death in child-bearing during the period in which it appears that births (living and still) were reported with a reasonable degree of completeness, attention may now be turned to the consideration of rates calculated on less reliable birth data, for the period between 1875 and 1914, with the expectation that when compared with the rates based upon the whole female population it may be possible to form a more exact estimate than hitherto possible of the course of maternal mortality during this period. The courses of the rates calculated on these two bases (tables 124 and 127) show very distinct correspondences. From both is evident that there were very marked increases in the rates for puerperal fever between 1881 and 1889, 1891 and 1896, and 1901 and 1905. It is also clearly shown that the mortality for all other causes ran a much less uneven course than did that for puerperal fever. It would appear, then, that, while in the intermediate period the rates from causes connected with child-birth had risen to much higher levels, the rates were on the whole but little lower in 1915–1920 than in 1875–1880. What gain there was affected puerperal fever chiefly. The latter has been declining since about 1900.

Any attempt to correlate the course of child-bed mortality over the long period under review with the various factors known to influence it is beset with many difficulties. Of prime importance is the relative crudity of the rates on which its measurement must be based. In this regard, changes in the age distribution of the female population, race composition, opportunities for marriage, variations in the proportions of legitimate and illegitimate births, and those fluctuations in birth-rates which are dependent upon so many other social circumstances, as well as upon the occurrence of epidemics, and which therefore chiefly determined the number exposed to risk, are all left out of consideration. From the standard of measurement available, it appears that maternal mortality in child-bed has run in rather definite waves and that since 1875, while to some extent these waves and their peaks have been associated with variations in the mortality from causes other than puerperal fever, on the whole they have been influenced to a much greater degree by rises and declines in the rate of the latter cause. Since in the past 20 years, when the

birth-rate has probably varied within narrow limits, the rate from puerperal fever has shown a perceptible decline and the rate for other causes on the whole has fallen but slightly, it seems likely that the very distinct waves of

TABLE 127.—*Number of deaths and rate of death, per 100,000 recorded births, living and still, from causes connected with child-birth, from 1875 to 1920, inclusive.*

D = death. R = rate.

Year.	Total puerperal state.		Puerperal septicemia.			Total puerperal state excluding puerperal septicemia.		
	D	R	D	R	Per cent of total puerperal state.	D	R	Per cent of total puerperal state.
1875	60	687	25	286	41.7	35	401	58.3
1876	48	612	13	166	27.1	35	447	72.9
1877	59	826	28	392	47.5	31	434	52.5
1878	58	864	26	387	44.8	32	477	55.2
1879	67	814	19	231	28.4	48	583	71.6
1880	83	877	40	423	48.2	43	454	51.8
1881	66	721	25	273	37.9	41	448	62.1
1882	87	1031	38	450	43.7	49	581	56.3
1883	82	953	41	476	50.0	41	476	50.0
1884	96	1081	44	495	45.8	52	586	54.2
1885	97	1156	48	572	49.5	49	584	50.5
1886	111	1319	55	654	49.5	56	665	50.5
1887	95	977	53	545	55.8	42	432	44.2
1888	97	1030	52	552	53.6	45	478	46.4
1889	87	857	39	384	44.8	48	473	55.2
1890	96	941	34	333	35.4	62	608	64.6
1891	118	1163	52	512	44.1	66	650	55.9
1892	114	1113	54	527	47.4	60	586	52.6
1893	138	1393	78	787	56.5	60	606	43.5
1894	92	911	40	396	43.5	52	515	56.5
1895	109	1249	66	756	60.6	43	493	39.4
1896	117	1235	54	570	46.2	63	665	53.8
1897	75	789	34	358	45.3	41	431	54.7
1898	65	681	22	231	33.8	43	451	66.2
1899	108	1236	27	309	25.0	81	927	75.0
1900	126	1350	31	332	24.6	95	1018	75.4
1901	126	1331	55	581	43.6	71	750	56.4
1902	117	1227	62	645	53.0	55	572	47.0
1903	111	1186	58	620	52.3	53	566	47.7
1904	106	1139	59	634	55.7	47	505	44.3
1905	102	1045	56	573	54.9	46	471	45.1
1906	102	1027	43	433	42.2	59	594	57.8
1907	87	911	43	450	49.5	44	460	50.5
1908	92	921	45	450	48.9	47	471	51.1
1909	103	1071	37	385	35.9	66	687	64.1
1910	86	805	27	253	31.4	59	552	68.6
1911	87	870	33	330	37.9	54	540	62.1
1912	105	869	43	356	41.0	62	513	59.0
1913	112	833	49	364	43.7	63	468	56.3
1914	84	615	35	256	41.7	49	359	58.3
1915	80	542	25	169	31.2	55	373	68.8
1916	104	637	35	215	33.7	69	423	66.4
1917	91	561	32	197	35.2	59	364	64.8
1918	119	722	31	188	26.1	88	534	74.0
1919	143	754	40	211	28.0	103	543	72.0
1920	133	659	40	198	30.1	93	461	69.9

child-bed mortality previous to 1875 were associated mainly with variations in the prevalence and severity of puerperal infection.

In connection with the high wave of mortality in the 10-year period after 1845, it is of interest to recall that Buckler recorded that in this period the

obstetric ward of the almshouse infirmary was closed a number of times on account of severe epidemics of puerperal fever. This affection was doubtless responsible for a considerable proportion of the high wave of child-bed mortality at this time as well as in the second, third, fourth, seventh, and eighth decades of the nineteenth century. With the exception of the wave in the fourth and fifth decades just referred to, high death-rates from erysipelas and puerperal fever were not synchronous. The well-known relation between scarlet fever and puerperal infection suggests a comparison in this connection. In the period before 1875 high rates for scarlet fever and child-birth sychronized in 1836–1837, 1844–1859, and 1866–1874. Between 1876 and 1888 and between 1901 and 1904, rates for scarlet fever and puerperal fever were both relatively high. In view of these coincidences and the established facts of the intimate causal relation between scarlet fever and puerperal infection, the inference seems warranted that child-bed mortality in Baltimore has been strongly influenced by these two affections.

Perhaps in no other medical center in the United States have the extremes of the obstetric art been so well represented as in Baltimore. From the time of Buchanan in the eighteenth century, the city has at no time lacked able and skilled teachers and practitioners of obstetrics. Owing to lack of facilities for practical teaching, and in many instances to the poor material among the students of proprietary schools, a large proportion of the general physicians has been poorly trained in obstetrics. Midwives have flourished since the earliest days. Without schools for instruction and without oversight worthy of the name they have been and are, in general, ignorant and inept in the art. As late as 1920 over 200 were registered as in practice. In 1920, of 18,787 living births, 26.1 per cent were attended by midwives. As the percentage of whites was 26.5 and of negroes 23.3, it is evident that the higher maternal mortality in the latter can not be attributed to midwives. Baltimore was fortunate in the absence of lying-in hospitals in the days previous to antisepsis, when obstetric hospitals were often so deadly. With the exception of a few beds at the almshouse infirmary and in not over two hospitals in the city, obstetrical hospitals can hardly have been said to have existed here before the ninth decade of the nineteenth century. At this period lying-in hospitals were established under careful obstetricians in connection with the University of Maryland and other medical schools. In 1895 the obstetrical wards of the Johns Hopkins Hospital were opened.

While no one of these hospital services has ever been large enough to accommodate more than a small proportion of parturient women, they have been sufficient on the whole to care for all of the serious cases needing hospitalization encountered in the extensive out-patient departments connected with them. According to a conservative estimate, in 1917 about one-fourth of all the deliveries in the city occurred under the care of these institutions, either in the hospitals or in homes, mostly by medical students under competent supervision. To these services, to antisepsis, and to improved opportunities for obstetrical teaching, the decline in the maternal death-rate from causes connected with child-birth is doubtless largely to be attributed. It is evident, from the high maternal and still-birth rates yet obtaining, that obstetrical care of women is far from adequate. The obstetrical clinics established at the writer's suggestion under the health department in 1919 have not been developed sufficiently to make an impression on the problem.

Chapter XVIII.—Ill-Defined Causes.

Diseases of early infancy; Arthritis; Hernia and Intestinal obstruction.
(Tables 128 to 132.)

DISEASES OF EARLY INFANCY.

By grouping together under three rubrics the deaths classified under various statistical headings that can be followed for longer or shorter periods in the mortality tables, it is possible to trace in general outline for 100 years the course of mortality from causes peculiar to infancy. These three rubrics are convulsions, marasmus, and causes unknown in infants. The annual rates for these are given in tables 128 and 132, respectively. In regard to age these rates are crude, and in regard to cause they are inexact, for it has been necessary to use as divisor the total estimated population, and the dividends are subject to errors of both inclusion and omission. It is likely, however, that these have tended to balance each other. These data have been submitted to all possible checks, the most important of which was the critical examination of a large number of the original death certificates of 1875 and other years. Here it was ascertained that, with few exceptions, the deaths certified under the headings included in these rubrics occurred in individuals in the first two years of life and, in the overwhelming majority of instances, in the early months of infancy. The same was found to hold true of the more definitive rubrics into which these various headings finally merged in the international classification in and after 1899. Further justification of the use of these data in this connection will appear from the following analysis:

CONVULSIONS.

This rubric (table 128), appearing annually without intermission since 1812, was characterized by rates particularly high from 1812 to 1840 and from 1866 to 1892. While it probably included some deaths of infants, of older children, and even of adults with convulsions associated with uræmia, whooping-cough, scarlet fever, and meningitis, from the relative magnitude of the rates in the earlier years it seems improbable that errors from these sources were large. It was apparently synonymous with convulsions of infants (later rubric 71), into which it merged in 1899.

MARASMUS.

(Table 128.)

This term is used for this rubric because it was the first member of this category of causes of death to appear in the statistical nosology. Except for a few years in the fifth decade of the nineteenth century, it was annually credited with a considerable number of deaths from 1820 to 1898, when it disappeared. Next to appear was debility in 1851. To this heading was ascribed

TABLE 128.—*Number of deaths and rate of death, per 100,000 living inhabitants, from convulsions, marasmus, rheumatism and gout, senility, hernia and intestinal obstruction, and appendicitis and typhlitis, from 1812 to 1920, inclusive.*

D = death. R = rate.

Year.	Convulsions.		Marasmus.*		Rheumatism and gout.						Senility.		Hernia and intestinal obstruction.		Appendicitis and typhlitis.	
					Chronic rheumatism and gout.		Imflammatory rheumatism.		Total.							
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1812..	64	156	....	...	3	7	....	....	3	7	42	103	....	....	....	....
1813..	115	269	....	...	1	2	....	....	1	2	62	145	....	....	....	....
1814..	80	179	....	...	2	4	....	....	2	4	69	154	....	....	....	....
1815..	98	210	....	...	2	4	....	....	2	4	83	178	....	....	....	....
1816..	91	186	....	...	6	12	....	....	6	12	54	111	....	....	....	....
1817..	98	192	....	...	3	6	....	....	3	6	57	112	....	....	....	....
1818..	115	216	....	...	1	2	....	....	1	2	62	117	....	....	....	....
1819..	92	166	....	...	6	11	2	4	8	14	77	139	....	....	....	....
1820..	90	156	6	10	2	3	....	....	2	3	78	135	....	....	....	....
1821..	84	139	15	25	5	8	....	....	5	8	93	154	....	....	....	....
1822..	83	132	46	73	11	18	1	2	12	19	87	138	....	....	....	....
1823..	60	92	13	20	9	14	....	....	9	14	69	105	....	....	....	....
1824..	46	68	1	1	4	6	....	....	4	6	72	106	....	....	....	....
1825..	47	66	35	49	2	3	....	....	2	3	69	97	....	....	....	....
1826..	55	75	10	14	4	5	1	1	5	7	107	145	....	....	....	....
1827..	63	82	27	35	4	5	3	4	7	9	71	93	....	....	....	....
1828..	68	86	27	34	2	3	....	....	2	3	93	117	....	....	....	....
1829..	68	82	89	108	3	4	....	....	3	4	107	130	....	....	....	....
1830..	70	82	82	96	5	6	....	....	5	6	94	110	....	....	....	....
1831..	78	88	32	36	8	9	1	1	9	10	104	117	....	....	....	....
1832..	89	97	55	60	7	8	1	1	8	9	164	178	....	....	....	....
1833..	110	115	27	28	2	2	2	2	4	4	87	91	....	....	....	....
1834..	93	94	17	17	2	2	1	1	3	3	126	127	....	....	....	....
1835..	89	87	30	29	2	2	....	....	2	2	120	117	....	....	....	....
1836..	92	87	27	25	..	..	2	2	2	2	137	129	....	....	....	....
1837..	90	82	32	29	7	6	....	....	7	6	93	85	....	....	....	....
1838..	89	79	30	26	2	2	3	3	5	4	94	83	....	....	....	....
1839..	68	58	18	15	4	3	2	2	6	5	118	101	....	....	....	....
1840..	55	45	3	2	7	6	2	2	9	7	96	79	....	....	....	....
1841..	84	67	5	4	8	6	....	....	8	6	98	78	....	....	....	....
1842..	84	65	5	4	11	9	1	1	12	9	98	76	....	....	....	....
1843..	58	44	2	2	5	4	4	3	9	7	120	90	....	....	....	....
1844..	73	53	....	...	6	4	1	1	7	5	93	68	....	....	....	....
1845..	81	57	1	1	1	1	6	4	7	5	97	69	....	....	....	....
1846..	73	50	....	...	2	1	4	3	6	4	129	88	....	....	....	....
1847..	81	54	....	...	5	3	2	1	7	5	144	96	....	....	....	....
1848..	106	69	....	...	4	3	5	3	9	6	156	101	....	....	....	....
1849..	97	61	1	1	8	5	1	1	9	6	171	107	....	....	....	....
1850..	92	56	....	...	3	2	6	4	9	5	140	85	2	1	....	....
1851..	99	59	1	1	8	5	....	....	8	5	156	93	3	2	....	....
1852..	102	59	....	...	11	6	....	....	11	6	174	100	4	2	....	....
1853..	136	76	30	17	7	4	....	....	7	4	180	101	1	1	....	....
1854..	116	63	184	100	7	4	....	....	7	4	184	100	7	4	....	....
1855..	136	72	18	10	13	7	....	....	13	7	202	107	3	2	....	....
1856..	127	66	8	4	11	6	....	....	11	6	188	97	2	1	....	....
1857..	92	46	....	...	15	8	....	....	15	8	185	93	4	2	....	....
1858..	134	66	1	...	8	4	....	....	8	4	211	104	1	....	....	....
1859..	106	51	5	2	13	6	....	....	13	6	160	77	....	....	....	....
1860..	112	52	2	1	11	5	....	....	11	5	215	100	4	2	....	....
1861..	106	48	4	2	11	5	....	....	11	5	215	98	3	1	....	....
1862..	98	43	6	3	21	9	....	....	21	9	190	84	2	1	....	....
1863..	103	45	31	13	26	11	....	....	26	11	204	88	5	2	....	....
1864..	91	38	33	14	21	9	....	....	21	9	202	85	1	....	....	....
1865..	100	41	22	9	23	9	....	....	23	9	167	69	2	1	....	....

* Including inanition, debility, asthenia, asphyxia neonatorum, atalectasis pulmonum, atrophy and premature birth. After 1899 these affections have been classified under congenital malformations, congenital debility, inanition and other diseases peculiar to infancy.

TABLE 128.—*Number of deaths and rate of death, per 100,000 living inhabitants, from convulsions, marasmus, rheumatism and gout, etc.*—Continued.

D = death. R = rate.

Year.	Convulsions.		Marasmus.*		Rheumatism and gout.						Senility.		Hernia and intestinal obstruction.		Appendicitis and typhlitis.	
					Chronic rheumatism and gout.		Inflammatory rheumatism.		Total.							
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1866..	202	81	46	19	20	8	....	....	20	8	219	88	2	1	....	....
1867..	209	82	22	9	12	5	....	....	12	5	188	74	3	1	....	....
1868..	301	116	26	10	28	11	....	....	28	11	199	76	1	....	....	....
1869..	289	108	67	25	49	18	....	....	49	18	229	86	1	....	....	....
1870..	298	109	74	27	34	12	....	....	34	12	327	120	2	1	....	....
1871..	312	112	46	16	38	14	....	....	38	14	299	107	....	....	....	....
1872..	305	107	33	12	53	19	....	....	53	19	314	110	10	4	....	....
1873..	267	92	53	18	62	21	....	....	62	21	335	115	9	3	....	....
1874..	328	110	63	21	48	16	....	....	48	16	289	97	8	3	....	....
1875..	308	73	475	151	53	17	....	....	53	17	211	69	34	11	....	....
1876..	361	116	533	171	50	16	....	....	50	16	240	77	26	8	....	....
1877..	306	96	554	174	46	14	....	....	46	14	211	66	23	7	....	....
1878..	294	91	512	158	6	2	16	5	22	7	212	65	23	7	....	....
1879..	323	97	538	162	3	1	28	8	31	9	255	77	25	8	....	....
1880..	367	108	622	184	6	2	26	8	32	9	251	74	30	9	....	....
1881..	419	121	620	179	7	2	32	9	39	11	251	73	19	6	1	....
1882..	362	103	590	167	4	1	20	6	24	7	305	86	36	10	....	....
1883..	388	108	625	174	4	1	17	5	21	6	259	72	20	6	2	1
1884..	342	93	680	185	10	3	19	5	29	8	282	77	37	10	3	1
1885..	366	98	672	180	14	4	15	4	29	8	291	78	34	9	3	1
1886..	319	84	755	198	15	4	32	8	47	12	248	65	28	7	....	....
1887..	348	89	690	177	18	5	20	5	38	10	291	75	30	8	2	1
1888..	304	72	724	173	24	6	23	5	47	11	318	76	43	10	4	1
1889..	289	68	803	188	22	5	19	4	41	10	313	73	54	13	1	....
1890..	311	72	793	182	32	7	24	6	56	13	350	81	58	13	6	1
1891..	352	80	837	189	25	6	11	2	36	8	431	98	55	12	6	1
1892..	334	74	785	175	17	4	21	5	38	8	417	93	58	13	9	2
1893..	259	57	840	184	28	6	24	5	52	11	329	72	53	12	13	3
1894..	267	58	775	167	49	11	5	1	54	12	323	70	40	9	22	5
1895..	293	62	828	176	37	8	4	1	41	9	317	67	41	9	18	4
1896..	285	60	799	167	45	9	7	1	52	11	300	63	52	11	25	5
1897..	252	52	815	168	40	8	4	1	44	9	255	52	76	16	34	7
1898..	301	61	910	185	48	10	1	....	49	10	362	73	54	11	34	7
1899..	221	44	761	152	64	13	....	....	64	13	358	72	57	11	52	10
1900..	277	55	919	181	41	8	....	....	41	8	339	67	75	15	63	12
1901..	332	65	951	185	20	4	12	2	32	6	373	73	90	18	57	11
1902..	168	32	1049	201	17	3	36	7	53	10	315	60	87	17	66	13
1903..	136	26	896	170	10	2	48	9	58	11	258	49	81	15	60	11
1904..	140	26	895	168	11	2	74	14	85	16	236	44	68	13	77	14
1905..	146	27	903	167	9	2	53	10	62	11	231	43	64	12	52	10
1906..	127	23	914	167	18	3	64	12	82	15	222	41	70	13	63	12
1907..	156	28	928	168	13	2	69	12	82	15	276	50	87	16	55	10
1908..	110	20	865	154	13	2	78	14	91	16	250	45	93	17	57	10
1909..	97	17	818	144	20	4	59	10	79	14	216	38	105	19	61	11
1910..	114	20	762	133	15	3	50	9	65	11	190	33	92	16	66	12
1911..	63	11	691	119	14	2	50	9	64	11	166	29	83	14	78	13
1912..	67	11	909	156	16	3	35	6	51	9	213	36	98	17	59	10
1913..	61	10	812	138	37	6	35	6	72	12	166	28	118	20	63	11
1914..	48	8	813	136	39	7	36	6	75	13	170	29	111	19	80	13
1915..	31	5	696	116	17	3	40	7	57	9	96	16	87	14	69	11
1916..	30	5	720	119	10	2	24	4	34	6	85	14	93	15	76	13
1917..	17	3	726	119	14	2	52	8	66	11	86	14	110	18	96	16
1918..	17	3	837	136	11	2	44	7	55	9	105	17	111	18	79	13
1919..	18	3	756	105	14	2	36	5	50	7	63	9	109	15	91	13
1920..	16	2	856	117	13	2	40	5	53	7	58	8	102	14	96	13

* Including inanition, debility, asthenia, asphyxia neonatorum, atalectasis pulmonum, atrophy and premature birth. After 1899 these affections have been classified under congenital malformations, congenital debility, inanition and other diseases peculiar to infancy.

a considerable number of deaths in certain years of the sixth, seventh, and eighth decades of the nineteenth century. By 1875 it was comparatively insignificant, and in 1899 it was absorbed in the new rubric, congenital debility. Inanition entered the statistical nosology in 1873, and from 1875 to 1909 to it a large number of deaths was annually attributed. To asthenia, atrophy, and asphyxia (the latter synonymous with atalectasis pulmonum) deaths were credited from 1875 to 1898. Appearing first in 1875, premature birth continued as an important assigned cause of death until 1898. All of these rubrics gave place in 1899 to the three rubrics embracing causes of death other than congenital malformations peculiar to early infancy. Since with few exceptions deaths from congenital malformations occur shortly after birth, and since, except under hydrocephalus, which in the earlier years held an entirely different significance (see meningitis), this cause can be traced but rarely, the conclusion is forced that before 1899 they were included under one of the headings of the group under discussion. The great and steady increase in the importance of the rubric congenital malformations since its introduction in 1899 can only be explained by change in custom of classification of deaths. For these reasons it has seemed necessary to include this rubric also. Indeed, it is not unlikely that most of the deaths in early infancy are in a broad sense due to congenital defects which render extra-uterine existence under adverse conditions impracticable.

DEATHS OF INFANTS FROM CAUSES UNKNOWN.

From table 132 it will be observed that this rubric appeared first in 1820, when distinction was made between deaths in infants and in adults from unknown causes. From the much higher rates which from 1820 were ascribed consistently under this heading to infants, it is reasonable to suppose that the same held good before this date. High rates characterized this rubric until 1875, after which, with the growing importance of the other rubrics under consideration, it gradually declined to insignificance, to disappear completely after 1893. After all, when obvious congenital defects and infections (syphilis, umbilical-cord infection, cholera infantum, and the eruptive and respiratory diseases) are excluded, most deaths of infants are really due to causes yet unknown, and former generations were not unwise in declining to accept names as true explanations. The rates for these three rubrics, convulsions, marasmus, and causes unknown, separately and combined as averaged for 5-year periods, are given in table 129. It is obvious at a glance that no one or two of these rubrics can be taken as the measure of the course of mortality for the causes under consideration. Taking the total for all three rubrics, it is found that from 1821 to 1920 the curve is a fairly consistent one. Starting at 371 for the period 1821–1825, the rate was well over 500 during the next three quinquennia. From 1841 to 1890, the rate, except for the period 1871–1875, did not depart far from 400. There was a slight fall from 380 for 1886–1890 to 357 for 1896–1900. No material change was brought about in the rate by the falling out after 1875 of causes unknown as an important rubric. The rubric marasmus immediately rose correspondingly.

If the assumptions and inferences upon which these rubrics have been set up are in the main valid, the fluctuations in the total rate between 1820 and 1900 are probably no greater than would be expected from errors of classification of deaths and variations, due to changes in the birth-rate, in the propor-

tional distribution in the population of individuals of the restricted age-group under consideration. Since 1900, however, a very considerable but gradual decline has taken place. From 357 for the period 1896–1900, the rate fell to 122 for that ending in 1920. In the 20 years since 1900 the rubrics of classification are clear-cut and no ambiguity as to their meaning and content befogs the question. All the evidence at hand indicates that the birth-rate can have varied but little during this period. Since deaths from the causes now under discussion occur almost exclusively in the first year of life and include a very large proportion of deaths from all causes (40 to 50 per cent) in this age-period, there should be a close correspondence between the course of the rates just discussed and the percentage of deaths under 1 year of age to the total deaths at all ages. As a matter of fact (table 138), the latter varied within

TABLE 129.—*Average rate of death, per 100,000 living inhabitants, by 5-year periods, from certain diseases of early infancy, from 1812 to 1920, inclusive.*

Periods.	Convulsions.	Marasmus.*	Total.	Causes unknown (infantile).	Total.	Periods.	Convulsions.	Marasmus.*	Total.	Causes unknown (infantile).	Total.
1812-15	163	....	163	....	163	1866-70	99	22	121	337	458
1816-20	183	....	183	....	183	1871-75	99	57	156	213	369
1821-25	99	34	133	238	371	1876-80	102	275	377	15	392
1826-30	81	57	139	400	539	1881-85	105	287	392	10	402
1831-35	96	34	130	443	573	1886-90	77	299	376	4	380
1836-40	70	20	89	444	533	1891-95	66	291	357	†4	361
1841-45	57	2	59	370	429	1896-1900 ..	54	303	357	....	357
1846-50	58	....	58	363	421	1901-05	35	178	213	....	213
1851-55	66	26	92	322	414	1906-10	22	153	175	....	175
1856-60	56	2	58	336	394	1911-15	9	133	142	....	142
1861-65	43	9	52	327	379	1916-20	3	119	122	....	122

* Including inanition, debility, asthenia, asphyxia neonatorum, atalectasis pulmonum, atrophy, and premature birth. After 1899, these affections have been classified under congenital malformations, congenital debility, inanition, and other diseases.

† Averaged for three years only.

comparatively narrow limits between 1816–1820 and 1886–1890, and for the latter period stood at 29 per cent. From this time the decline was steadily to 16 per cent for 1916–1920, a decrease of 45 per cent. In the same space of time, i. e., since 1890, the decline in the rate for causes peculiar to infancy was about 63 per cent. When due allowance is made for crudeness of the basis of comparison the correlation is strikingly high. An apter comparison is that between the averaged crude rates and the rates specific for the first year of life for this group of affections determined for the census years. These are found to be for 1850, 11,049; for 1860, 12,726; for 1880, 12,041; for 1890, 11,686; for 1900, 11,029; for 1910, 8,556; and for 1920, 5,871. Between 1850 and 1900 the decline in the average crude rate was 15 per cent and the change in the specific rate was negligible, while, since 1900, the former fell by 65 and the latter by 46 per cent. All things considered, the correspondence is close.

Whatever doubt may be thrown on the accuracy of the picture of the course of mortality from this group of causes during the previous 80 years, when the

rates for the initial and closing periods were approximately the same, there can be no question that during the last 20 years the rates must reflect actual experience with a reasonable degree of accuracy. While the assumption that fatal syphilis was more common in the earlier years may not be successfully combated, and that in the period of the prevalence of certain diseases in severe and often epidemic states premature births were probably more common must be acknowledged, more adequate explanations than these are needed to account for the recent sensible drop in mortality from a group of affections in the causation of which infectious processes other than syphilis play a subordinate rôle.

On the other hand, in the period of falling rates there have been in play, and with a correspondingly increasing intensity of activity, a set of influences rightly designed to accomplish this very purpose. In so far as deaths from causes peculiar to infancy are preventable, the result is reached by improvement in the care of infants before and after birth. It was in this 20-year period

TABLE 130.—*Number of deaths and rate of death, per 100,000 live-births, from certain diseases of early infancy and number of live-briths, according to color and sex, for 1920.*

D = death. R = rate.

	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
Number of live-births	18787		15934		8159		7775		2853		1436		1417	
Convulsions	16	85	12	75	8	98	4	51	4	140	3	209	1	71
Congenital malformations	190	1011	157	985	94	1152	63	810	33	1157	16	1114	17	1200
Congenital debility	510	2715	394	2473	220	2696	174	2238	116	4066	65	4526	51	3599
Other diseases peculiar to early infancy	155	825	121	759	69	846	52	669	34	1192	21	1462	13	917
Lack of care	1	5	1	6	...	....	1	13	...	....	...	....	...	....
Total	872	4642	685	4299	391	4792	294	3781	187	6555	105	7312	82	5787

that obstetric teaching and practice improved, obstetrical facilities were extended, modern pediatrics with dispensaries and hospital care developed, and instruction of mothers through the Visiting Nurse and the Babies Milk Fund Associations has been carried out on an ever-increasing scale. Owing to the exposure of the deadly foundling asylums by a special committee, since 1914 the doors of these institutions have been closed to infants under 6 months of age. A class of babies heretofore condemned to almost certain death have thus been retained in the care of their mothers during the most risky period of existence.

In the same period the racial complex of the population has undergone changes favorable to decrease in infant mortality. The proportion of negroes to whites has decreased, and the ratio of race stocks—Polish Jews, Poles, and Italians—among whom infant suckling is the rule—has increased. On the basis of the live-births reported, rates specific for sex and color for the rubrics covering deaths really peculiar to infants in 1920 are given in table 130.

From this table it is clear that not only for the total of all the rubrics, but for each separate rubric where the figures are large enough to be significant, the rates were much higher among negroes than among whites and among males than among females. Of the total number of those deaths, the percentage for each rubric that occurred within the first year of life was as follows: convulsions, 81; congenital malformations, 95; congenital debility, 98; other diseases of infants and lack of care, each, 100. There occurred during the first month of life of the total number dying under 1 year of age, of convulsions, 31 per cent; of congenital malformations, 69 per cent; of congenital debility, 85 per cent; of other diseases of infancy, 97.4 per cent; and of lack of care, 100 per cent. There can be little doubt, therefore, that this group of causes of death corresponds to those that have been discussed above.

ARTHRITIS.

Deaths have been classified in the mortality tables as due to gout or rheumatism, either chronic or unqualified, with a single exception, in each year since 1812. To acute rheumatism were assigned a few deaths in occasional years

TABLE 131.—*Average rate of death, per 100,000 living inhabitants, by 5-year periods, from rheumatism and gout, senility, hernia and intestinal obstruction, and appendicitis, from 1812 to 1920, inclusive.*

Periods.	Rheumatism and gout.			Hernia and intestinal obstruction.	Appendicitis and typhlitis.	Periods.	Rheumatism and gout.			Hernia and intestinal obstruction.	Appendicitis and typhlitis.
	Chronic rheumatism and gout.	Inflammatory rheumatism.	Total.				Chronic rheumatism and gout.	Inflammatory rheumatism.	Total.		
1812-15	5	....	5	....	....	1866-70	11	....	11	1	....
1816-20	7	1	8	....	....	1871-75	17	....	17	4	....
1821-25	10	....	10	....	....	1876-80	7	4	11	8	....
1826-30	5	1	6	....	....	1881-85	2	6	8	8	....
1831-35	5	1	6	....	....	1886-90	5	6	11	10	1
1836-40	3	2	5	....	....	1891-95	7	3	10	11	3
1841-45	5	2	7	....	....	1896-1900 ..	9	1	10	13	8
1846-50	3	2	5	....	....	1901-05	3	8	11	15	12
1851-55	5	....	5	2	....	1906-10	3	11	14	16	11
1856-60	6	....	6	1	....	1911-15	4	7	11	17	12
1861-65	9	....	9	1	....	1916-20	2	6	8	16	13

between 1819 and 1850. This rubric disappeared completely from 1851 to 1878. It reappeared, however, in 1878, and with the exception of two years it has been credited with deaths in each succeeding year. The annual data for these two rubrics are presented in table 128. These do not include deaths ascribed to disease of the hip-joint, the knee, and the spinal vertebræ, which have elsewhere been classified under tuberculosis. They do include, however, deaths from all other anatomical and etiological varieties of arthritis. It has not been possible to distinguish between true gout and other forms of arthritis, and it is evident from the table that not until 1901 and after is any significant distinction between acute and chronic arthritis warranted.

Taking the recorded figures at their face value, and using for convenience rates averaged for 5-year periods (table 131), the mortality from presumably

non-tuberculous arthritis as a whole may be studied with some profit. Up until 1865 an average rate of from 5 to 7 obtained in each period, except in 1816–1820, 1821–1825, and 1861–1865, when it was 8, 10, and 9, respectively. After 1865 the rate held remarkably steady at 10 or 11 in 7 out of 11 periods. It fell to 8 in the periods 1881–1885 and 1916–1920, and rose to 17 and to 14, respectively, between 1871 and 1875 and 1906 and 1910. It will be noted that the rate was the same in 1816–1820 and 1916–1920. In the 20 years 1901–1920, during which it may be followed separately with some degree of certainty, the rate for acute rheumatism varied from 6 to 11, relatively wide extremes. This suggests that the fluctuations noted in the total rate in earlier years may have been due, in large measure at least, to exacerbations in the mortality of acute arthritis of the type commonly known as acute inflammatory rheumatism.

HERNIA AND INTESTINAL OBSTRUCTION.

Deaths under this rubric can not be traced in the mortality tables before 1850, and for many subsequent years most of the small mortality from these causes was classified under hernia. It was not until 1875 that the annual rates (table 128) became significant. Beginning in this year with a rate of 11, and fluctuating during the following 13 years between 6 and 10, the annual rate reached 13 in 1889. In only two years since this date did the rate again fall below 11. After 1899 the course of the annual rates follows definite short waves of irregular length, with rates in the peak year of 18 in 1901, 19 in 1909, 20 in 1913, and 18 in 1917 and 1918.

When averaged for 5-year periods (table 131), the rate was 8 from 1876 to 1885, 10 from 1886 to 1890, 11 from 1891 to 1895, and 13 from 1896 to 1900. During the next 20 years, a period of more discriminating classification of deaths and of more frequent surgical intervention, with perfected technique in this group of affections for which mechanical measures offer almost the sole hope of prevention and cure, the rate as averaged for 5-year periods has remained almost stationary—from 15 to 17. At first sight it would appear that rates of this level represent the natural inevitable mortality from this group of causes. Analysis of the facts and probabilities of the case shows that this view is untenable. In the first place, while improvements in diagnosis and classification have undoubtedly relegated to other rubrics many deaths which before 1899 would have been classified under this heading, it is certain that many deaths following acute intestinal obstruction within a few days after abdominal operations have been assigned to this rubric, instead of to those covering the affections for which operation was undertaken. Personal experience has demonstrated that the utmost care is required to avoid this trap, which, owing to ignorance or intention on the part of surgeons, is so frequently set for statistical clerks. In the second place, as a result of the greatly increased frequency and impunity with which abdominal operations have been undertaken in this period, and the relatively small immediate fatality, there has accumulated in the population a not inconsiderable number of persons with intestinal adhesions or even progressive chronic peritonitis, likely to cause obstruction of the intestines. Therefore it may well be that the very measures beneficent in so many respects, which in many instances ward off death from some affections belonging under this group, have in one way or another served to stabilize its officially recorded death-rate at a relatively high level.

PART VIII.—GENERAL CONCLUSIONS.

Chapter XIX.—Deaths from All Causes.

(Tables 132 to 139, graphs 35 to 41.)

From table 132 and graph 35 it will be observed that for the population as a whole the course of mortality has varied widely during the 109 years under review. Throughout most of this period, however, with few exceptions, as, for instance, about 1819, 1832, 1872, and 1918—all years of unusual epidemics marked by extraordinary mortality—any striking fluctuations in the annual rates extended over considerable periods of years. Until 1895, the curve of the annual rates ran a wave-like course. Between 1812 and 1817, the rate varied between 2,892 and 2,598. Rising to 3,226 in 1818 and to 3,933, the highest ever attained, in 1819, the rate fell to 2,639 in 1820. Ascending to 3,499 in 1822, the rate declined to 2,006 in 1824 and to 1,824 in 1827. During the next 4 years the rate ascended gradually to 2,459 in 1831. Under the influence of severe epidemics of cholera and influenza and a moderate visitation of small-pox in 1832, the rate reached 3,720. By 1835 the rate had fallen to 1,852, and in 9 of the succeeding years it was under 2,100; in 1840 it was as low as 1,690. From 1847 the rate gradually ascended until 1854, when it reached 2,916. From this level there was a gradual though somewhat irregular decline to 1,935 in 1865. A second long wave beginning in 1866 reached its peak with a rate of 3,103 in 1872, and by 1878 had fallen to 2,073. From 1879 to 1883 the rate gradually ascended to 2,607, and from this level there was a continuous decline to 2,038 in 1889. From this time until 1907, except for slight rises in 1890–1892 and in 1895, the rate fluctuated between 2,100 and 1,923. During the following 10 years the rate was always below 1,900, and in one year, 1915, below 1,700. It rose to 2,596 in 1918, to fall to the lowest recorded levels, 1,585 and 1,548 in 1919 and 1920, respectively. It will be observed that, while in several years in the third, fourth, fifth, and seventh decades the rate fell below 2,000, it was not until the twentieth century that rates so low were common, nor until after 1908 were they of constant (except in 1918) occurrence. It was only after 1895 that these marked waves of increased mortality ceased to appear.

In considering the difference in the course of mortality in the white and negro races, and in comparing the curves for these with that for the total population, it must be borne in mind that until 1857 the rates for whites and negroes separately are based on figures which include still-births. This is due to the fact that until this date in the tables of mortality the white and negro still-births were not tabulated separately. In consequence these rates are for this period somewhat higher than would be the true rates calculated on the usual basis, and the difference between the white rate and the total rate is less marked and between the total rate and the negro rate is more pronounced than would be the case but for this fault in the original data. As throughout

TABLE 132.—*Deaths from all causes, exclusive of still-births,* per 100,000 living inhabitants, from 1812 to 1920, inclusive.*

D = death. R = rate.

Year.	Total.										Causes unknown.						Still-births.	
	Total.		White.		Colored.						Total.		Adult.		Infant.			
					Total.		Free.		Slave.									
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1812	1184	2892	.....	.....	.....	.....	.....	.....	.....	.....	77	188	.....	.....	.....	.....	113	276
1813	1145	2677	.....	.....	.....	.....	.....	.....	.....	.....	75	175	.....	.....	.....	.....	108	252
1814	1152	2575	.....	.....	.....	.....	.....	.....	.....	.....	39	87	.....	.....	.....	.....	70	156
1815	1349	2887	.....	.....	.....	.....	.....	.....	.....	.....	60	128	.....	.....	.....	.....	90	193
1816	1317	2698	.....	.....	.....	.....	.....	.....	.....	.....	54	111	.....	.....	.....	.....	78	160
1817	1324	2598	934	2418	390	3162	.....	.....	.....	.....	59	116	.....	.....	.....	.....	117	230
1818	1716	3226	1234	3043	578	4573	.....	.....	.....	.....	109	205	.....	.....	.....	.....	96	180
1819	2182	3933	1716	4034	571	4409	.....	.....	.....	.....	91	164	.....	.....	.....	.....	105	189
1820	1527	2639	1137	2550	488	3678	.....	.....	.....	.....	68	118	2	3	66	114	98	169
1821	1910	3167	1592	3408	423	3112	.....	.....	.....	.....	103	171	15	25	88	146	105	174
1822	2198	3499	1737	3552	582	4180	.....	.....	.....	.....	117	186	8	13	109	174	121	193
1823	2000	3057	1449	2832	659	4621	.....	.....	.....	.....	201	307	42	64	159	243	108	165
1824	1366	2006	1052	1967	416	2848	368	.....	48	.....	253	372	32	47	221	325	102	150
1825	1453	2051	1156	2069	389	2600	332	.....	57	.....	250	353	34	48	216	305	92	130
1826	1825	2478	1396	2393	526	3434	429	.....	97	.....	417	566	62	84	355	482	97	132
1827	1398	1824	1081	1776	417	2658	357	.....	60	.....	316	412	45	59	271	354	100	130
1828	1612	2027	1262	1989	440	2738	340	.....	100	.....	355	446	35	44	320	402	90	113
1829	1743	2111	1320	1997	529	3215	429	.....	100	.....	364	441	48	58	316	383	106	128
1830	1974	2304	1519	2207	567	3364	478	3232	89	2158	358	418	31	36	327	382	112	131
1831	2185	2459	1676	2341	632	3662	514	.....	118	.....	417	469	49	55	368	414	123	138
1832	3427	3720	2410	3237	1162	6573	998	.....	164	.....	508	551	29	31	479	520	145	157
1833	2279	2387	1773	2291	632	3491	534	.....	98	.....	440	461	14	15	426	446	126	132
1834	2600	2629	2026	2521	711	3834	596	.....	115	.....	479	484	30	30	449	454	137	139
1835	1896	1852	1469	1761	581	3059	484	.....	97	.....	409	399	18	18	391	382	154	150
1836	2192	2069	1674	1935	699	3594	595	.....	104	.....	494	466	16	15	478	451	181	171
1837	2518	2297	1997	2227	717	3599	584	.....	133	.....	529	483	13	12	516	471	196	179
1838	2476	2185	2019	2173	672	3294	526	.....	146	.....	565	499	30	26	535	472	215	190
1839	2260	1929	1809	1880	622	2977	483	.....	139	.....	535	457	20	17	515	440	171	146
1840	2045	1690	1712	1719	524	2449	413	2298	111	3470	514	425	46	38	468	387	191	158
1841	2247	1798	1813	1759	635	2898	504	.....	131	.....	516	413	29	23	487	390	201	161
1842	2477	1920	1969	1848	686	3057	569	.....	117	.....	515	399	25	19	490	380	178	138

1843	2335	1755	1915	1739	607	2641	472	.....	135	.....	493	370	47	35	446	335	187	141
1844	2665	1942	2242	1971	637	2707	512	.....	125	.....	548	399	82	60	466	339	214	156
1845	2896	2046	2383	2029	724	3004	617	.....	107	.....	660	466	85	60	575	406	211	149
1846	2994	2053	2493	2057	758	3072	590	.....	168	.....	620	425	87	60	533	365	257	176
1847	3414	2272	3024	2419	771	3052	551	.....	220	.....	683	455	96	64	587	391	381	254
1848	3861	2495	3312	2570	921	3561	649	.....	272	.....	667	431	178	115	489	316	372	240
1849	4165	2615	3519	2649	1057	3993	791	.....	266	.....	755	474	137	86	618	388	411	258
1850	4210	2568	3725	2722	900	3321	641	2912	259	8810	657	401	72	44	585	357	415	253
1851	4169	2472	3640	2583	899	3241	670	.....	229	.....	641	380	75	44	566	336	370	219
1852	4965	2863	4373	3015	940	3311	726	.....	214	.....	748	431	101	58	647	373	348	201
1853	4803	2694	4342	2909	808	2781	673	.....	135	.....	655	367	101	57	554	311	347	195
1854	5343	2916	4804	3130	879	2957	812	.....	67	.....	546	298	107	58	439	240	340	186
1855	5075	2696	4507	2856	958	3149	832	.....	126	.....	783	416	119	63	664	353	390	207
1856	5229	2705	4711	2904	957	3075	880	.....	77	.....	887	459	151	78	736	381	439	227
1857	5120	2579	4217	2530	903	2836	792	.....	111	.....	813	410	151	76	662	333	433	218
1858	5407	2654	4554	2660	853	2619	749	.....	104	.....	782	384	139	68	643	316	378	186
1859	4674	2235	3882	2209	792	2377	700	.....	92	.....	805	385	144	69	661	316	365	175
1860	4866	2269	4025	2231	841	2468	735	2870	106	4791	872	407	156	73	716	334	402	187
1861	4790	2178	3935	2126	855	2454	725	.....	130	.....	817	371	133	60	684	311	366	166
1862	5173	2294	4447	2342	726	2038	643	.....	83	.....	860	381	158	70	702	311	229	102
1863	5551	2402	4719	2424	832	2284	800	.....	32	.....	973	421	159	69	814	352	320	138
1864	5678	2397	4716	2363	962	2584	957	.....	5	.....	1023	432	165	70	858	362	344	145
1865	4695	1935	3839	1877	856	2249	.....	.....	.....	.....	832	343	111	46	721	297	337	139
1866	5623	2263	4608	2199	1015	2609	.....	.....	.....	.....	1002	403	170	68	832	335	398	160
1867	5284	2077	4336	2020	948	2385	.....	.....	.....	.....	957	376	172	68	785	309	391	154
1868	6178	2372	5176	2355	1002	2467	.....	.....	.....	.....	994	382	174	67	820	315	360	138
1869	6497	2438	5258	2337	1239	2986	.....	.....	.....	.....	1025	385	140	53	885	332	450	169
1870	7262	2663	5850	2540	1412	3331	.....	.....	.....	.....	1223	448	144	53	1079	396	529	194
1871	7141	2560	5751	2441	1390	3210	.....	.....	.....	.....	1040	373	139	50	901	323	468	168
1872	8852	3103	7159	2970	1693	3829	.....	.....	.....	.....	1113	390	149	52	964	338	531	186
1873	7589	2602	5921	2402	1668	3694	.....	.....	.....	.....	818	280	172	59	646	222	379	130
1874	7379	2475	6009	2384	1370	2971	.....	.....	.....	.....	516	173	23	8	493	165	375	126
1875	7258	2382	5704	2214	1554	3302	.....	.....	.....	.....	76	25	29	10	47	15	560	184
1876	7498	2409	5795	2201	1703	3545	.....	.....	.....	.....	77	25	23	7	54	17	588	189
1877	7910	2487	6059	2253	1851	3775	.....	.....	.....	.....	67	21	11	3	56	18	538	169
1878	6733	2073	5159	1878	1574	3145	.....	.....	.....	.....	52	16	9	3	43	13	655	202
1879	7618	2297	5883	2097	1735	3398	.....	.....	.....	.....	55	17	13	4	42	13	620	187
1880	8043	2376	6170	2154	1873	3595	.....	.....	.....	.....	52	15	11	3	41	12	636	188
1881	8816	2551	6719	2298	2097	3945	.....	.....	.....	.....	58	17	17	5	41	12	651	188
1882	8925	2531	6880	2305	2045	3772	.....	.....	.....	.....	60	17	7	2	53	15	677	192
1883	9380	2607	7125	2340	2255	4078	.....	.....	.....	.....	60	17	18	5	42	12	701	195
1884	8293	2259	6398	2059	1895	3361	.....	.....	.....	.....	30	8	10	3	20	5	746	203
1885	8153	2178	6324	1996	1829	3181	.....	.....	.....	.....	27	7	8	2	19	5	650	174
1886	8339	2184	6477	2004	1862	3177	.....	.....	.....	.....	25	7	3	1	22	6	718	188
1887	8372	2151	6380	1936	1992	3334	.....	.....	.....	.....	20	5	2	1	18	5	699	180

* Number of deaths and the rates of death for white and colored include still-births from 1818 to 1856, inclusive.

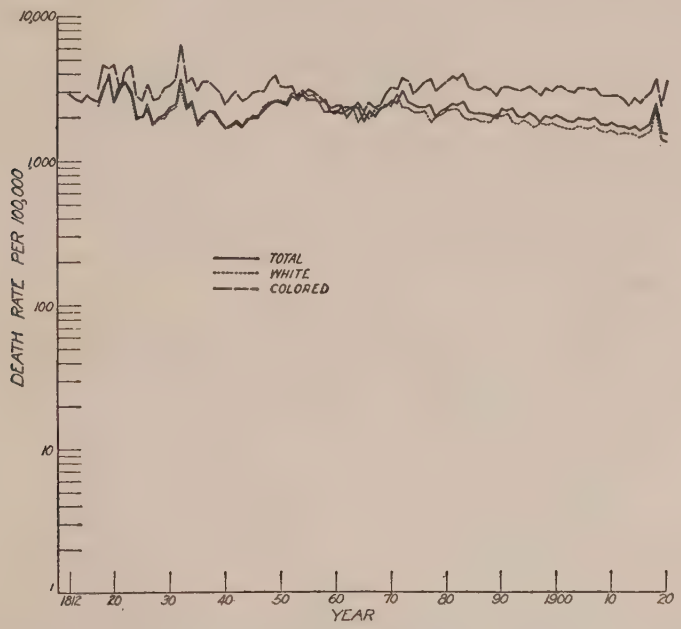
TABLE 132.—*Deaths from all causes, exclusive of still-births.*—Continued.

D = death. R = rate.

Year.	Total.										Causes unknown.						Still-births.	
	Total.		White.		Colored.						Total.		Adult.		Infant.			
					Total.		Free.		Slave.									
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
1888	8936	2130	6894	1937	2042	3205	.....	.....	.....	.....	17	4	3	1	14	3	694	165
1889	8703	2038	6819	1883	1884	2905	.....	.....	.....	.....	15	4	2	.....	13	3	784	184
1890	10198	2347	8026	2178	2172	3291	.....	.....	.....	.....	19	4	5	1	14	3	800	184
1891	10073	2279	7838	2091	2235	3328	.....	.....	.....	.....	30	7	11	2	19	4	811	183
1892	10582	2355	8361	2194	2221	3251	.....	.....	.....	.....	27	6	10	2	17	4	813	181
1893	9554	2091	7370	1903	2184	3143	.....	.....	.....	.....	16	4	5	1	11	2	770	169
1894	9486	2044	7242	1840	2244	3178	.....	.....	.....	.....	15	3	.....	.....	.....	.....	721	155
1895	10301	2185	7884	1973	2417	3365	.....	.....	.....	.....	29	6	.....	.....	.....	.....	666	141
1896	9919	2072	7612	1876	2307	3160	.....	.....	.....	.....	49	10	.....	.....	.....	.....	678	142
1897	9329	1920	7163	1740	2166	2920	.....	.....	.....	.....	27	6	.....	.....	.....	.....	706	145
1898	10385	2107	7908	1894	2477	3286	.....	.....	.....	.....	20	4	.....	.....	.....	.....	748	152
1899	10152	2030	7764	1833	2388	3119	.....	.....	.....	.....	60	12	.....	.....	.....	.....	701	140
1900	10700	2111	8093	1886	2607	3353	.....	.....	.....	.....	20	4	.....	.....	.....	.....	682	135
1901	10479	2039	7856	1806	2623	3323	.....	.....	.....	.....	22	4	.....	.....	.....	.....	672	131
1902	10253	1969	7733	1755	2520	3145	.....	.....	.....	.....	70	13	.....	.....	.....	.....	659	127
1903	10141	1923	7659	1717	2482	3052	.....	.....	.....	.....	95	18	.....	.....	.....	.....	741	140
1904	10818	2025	8096	1793	2722	3298	.....	.....	.....	.....	149	28	.....	.....	.....	.....	710	133
1905	10695	1978	7939	1737	2756	3292	.....	.....	.....	.....	224	41	.....	.....	.....	.....	814	151
1906	10753	1965	8033	1738	2720	3203	.....	.....	.....	.....	280	51	.....	.....	.....	.....	826	151
1907	11190	2021	8378	1792	2812	3266	.....	.....	.....	.....	279	50	.....	.....	.....	.....	794	143
1908	10435	1864	7874	1666	2561	2933	.....	.....	.....	.....	308	55	.....	.....	.....	.....	811	145
1909	10376	1833	7791	1631	2585	2921	.....	.....	.....	.....	326	58	.....	.....	.....	.....	817	144
1910	10753	1879	8146	1688	2607	2907	.....	.....	.....	.....	313	55	.....	.....	.....	.....	822	144
1911	10404	1799	7759	1592	2645	2911	.....	.....	.....	.....	226	39	.....	.....	.....	.....	712	123
1912	10441	1787	7880	1601	2561	2782	.....	.....	.....	.....	85	15	.....	.....	.....	.....	689	118
1913	10168	1723	7850	1580	2318	2487	.....	.....	.....	.....	45	8	.....	.....	.....	.....	909	154
1914	10551	1771	7914	1578	2637	2794	.....	.....	.....	.....	10	2	.....	.....	.....	.....	1026	172
1915	10002	1663	7525	1488	2477	2592	.....	.....	.....	.....	17	3	.....	.....	.....	.....	1131	188
1916	10719	1766	7983	1565	2736	2829	.....	.....	.....	.....	15	2	.....	.....	.....	.....	1235	203
1917	11364	1856	8362	1625	3002	3068	.....	.....	.....	.....	13	2	.....	.....	.....	.....	1267	207
1918	16032	2596	12312	2374	3720	3757	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1200	194
1919	11434	1585	8890	1441	2544	2440	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1327	184
1920	11356	1548	8779	1404	2577	2370	.....	.....	.....	.....	5	1	.....	.....	.....	.....	1398	191

* Number of deaths and the rates of death for white and colored include still-births from 1913 to 1920, inclusive.

the whole period the whites have constituted a so overwhelmingly large proportion of the population, their rate has been the determining factor in the rate for the whole population. It is not surprising, therefore, that before 1857 the white rate as calculated approaches or even surpasses the level of the total rate. As the chief interest in the comparison lies in the differences between the white and the negro rates, the inclusion of still-births in the earlier period is of relatively minor importance. Comparing the rates for these two elements in the population from 1817 to 1920, inclusive, it is notable that with the exception of a few years (1821, 1853, 1854, 1862, 1863), the negro rate was higher than the white rate. Except in 1821 and between 1851 and 1868, the difference in favor of the whites is striking. The near approach of the two



GRAPH 35 (from table 132). Annual crude mortality-rates from all causes in the whole population, in whites, and in negroes, from 1812 to 1920, inclusive.

rates in the sixth and seventh decades of the nineteenth century occurred in a period of very marked decline in the proportion of negroes to whites in the population. To a certain degree, at least, the decline in the rate for negroes in this period was also associated with the higher proportion of cases of smallpox and typhus fever in this race hospitalized without the city limits. With the exceptions above noted, there is a very definite correspondence between the course of the curves for the two rates, which rise and fall together, and but for the difference in their levels, the three curves follow much the same courses.

The course of the rate for whites followed so closely that of the rate for the whole population until 1875 that it is unnecessary to trace it separately. From 1885, with the exception of 1890 to 1892, inclusive, and 1918, the white rate never exceeded 2,000, and, after 1905, in only one year (1918) did it rise

above 1,800. It dropped below 1,500 for the first time in 1915, and in 1920 it fell to 1,404. In 1918, the year of the great influenza epidemic, this rate attained 2,374, a level relatively low when compared with certain earlier years. Particularly high rates in the earlier period were 3,043 in 1818, 4,034 in 1819 (yellow fever); 3,408, 3,552, and 2,832 in 1821, 1822, and 1823; 3,032 in 1832; 3,015, 2,909, 3,130, 2,856, and 2,904 in 1852, 1853, 1854, 1855, and 1856, respectively, and 2,970 in 1872. These very high rates were associated with years of severe visitations of yellow fever, cholera, typhus fever, or smallpox. The 6-year period between 1839 and 1844, when the rate never exceeded 2,000, was peculiarly healthy.

Between 1817 and 1852 the rate in negroes fell below 3,000 in only 8 years. The lowest rate recorded in this period was 2,449 in 1840. Extraordinarily high rates were 4,573, 4,409, 4,180, and 4,621 in 1818, 1819, 1822, and 1823, respectively; 6,573 in 1832, 3,829 in 1872, 3,775 in 1877, 3,945, 3,772, and 4,078 in 1881 to 1883, and 3,757 in 1918. Rates uniformly below 3,000 occurred between 1857 and 1869, and in this period rates under 2,400 were recorded in 5 years. Between 1870 and 1907, the rates fell below 3,000 in only two years. After the latter date the rate rose above 3,000 in only two years (1917 and 1918). From 1885 to 1907 the rates ran on a fairly even level and not far from 3,000. The decline to 2,440 and 2,370 for 1919 and 1920, respectively, while striking, did not bring the rate below levels previously recorded.

Turning now to rates averaged for 5-year periods (table 133, graph 36), the course of mortality from all causes can be followed with greater clearness. For the whole population the rates rose from 2,758 for the period 1812–1815 to 3,019 for the quinquennium ending in 1820. For the next 5 years the rate fell to the level of the first period, and for 1826–1830 it declined to 2,149. Between 1831 and 1835 the rate rebounded to 2,609, only to fall again to 2,034 for 1836–1840 and to the extremely low level of 1,892 for 1841–1845, a level not to be bettered until 1911–1915. The wave extending over the 20 years between 1846 and 1865 reached its peak with a rate of 2,728 for the 5-year period 1851–1855. Descending to 2,241 for the quinquennium 1861–1865, the rate gradually ascended again, and for the 5 years ending in 1875 was 2,625. Falling slightly between 1876 and 1880 and rising somewhat for the next 5-year period, the rate declined to 2,170 for the 5 years ending in 1890. After remaining practically stationary for the succeeding quinquennium, from 1896 the averaged rate fell steadily to 1,749 during the quinquennium 1911–1915. For 1916–1920 the rate was 1,870.

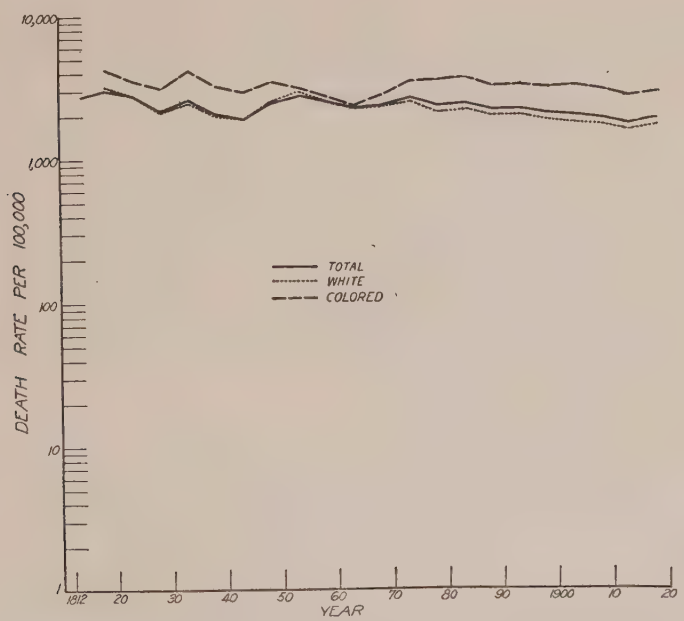
The curve of the white rate ran nearly parallel with that for the total rate until 1875. After this date it dropped substantially and almost unbrokenly until 1915. For the period 1841–1845, the rate for this category was only 1,870. The highest levels reached were 3,209 in 1816–1820, 2,766 in 1821–1826, and 2,899 in 1851–1855. The rate had declined to 1,988 by 1886–1890. The low point was reached in 1911–1915 with a rate of 1,568.

The rate for negroes, like the total rate and the white rate, fell continuously from 1816 to 1830, and also like these but for the ascent between 1831–1840 it would have continued at a comparatively low level until 1845. The peak periods 1816–1820 and 1831–1835 were characterized by the excessively high rates of 4,220 and 4,124, respectively. From a level of 2,861 for the quin-

TABLE 133.—*Average rate of death, per 100,000 living inhabitants, by 5-year periods, from all causes excluding still-births, total causes unknown, and still-births, from 1812 to 1920, inclusive.*

Periods.	Deaths from all causes, excluding still-births.			Total causes unknown.	Still-births.	Periods.	Deaths from all causes, excluding still-births.			Total causes unknown.	Still-births.
	Total.	White.*	Colored.*				Total.	White.*	Colored.*		
1812-15	2758	....	....	145	219	1866-70	2363	2290	2756	399	163
1816-20	3019	3209	4220	143	186	1871-75	2625	2482	3401	248	159
1821-25	2756	2766	3472	278	162	1876-80	2328	2116	3491	19	187
1826-30	2149	2073	3082	457	127	1881-85	2425	2199	3668	13	190
1831-35	2609	2430	4124	473	143	1886-90	2170	1988	3182	5	180
1836-40	2034	1986	3182	466	169	1891-95	2191	2000	3253	5	166
1841-45	1892	1870	2861	410	149	1896-1900 ..	2048	1846	3168	7	143
1846-50	2401	2484	3400	437	236	1901-05	1987	1762	3222	21	136
1851-55	2728	2899	3088	379	201	1906-10	1912	1703	3006	54	145
1856-60	2488	2507	2675	409	199	1911-15	1749	1568	2713	13	151
1861-65	2241	2226	2322	390	138	1916-20	1870	1682	2893	1	196

* These averages for white and colored include still-births until 1857.



GRAPH 36 (from table 133). Crude mortality-rates from all causes in the whole population, in whites, and in negroes, averaged by 5-year periods, from 1812 to 1920, inclusive.

quennium 1841–1846, the rate for negroes rose comparatively slightly during the succeeding 5 years and, in contrast to the rate for whites, instead of continuing to rise between 1851–1855 and attaining a higher peak, it entered upon a long decline covering the 15 years between 1851 and 1865, and for the period 1861–1865 stood at 2,322. These 15 years were a period of stagnation in negro immigration, during which the negro population declined actually and relatively. Again, after 1865 the course of the rate for negroes followed a course rather different from that pursued by the rate for whites. While between 1866 and 1875 the rate for whites showed only a slight increase, that for negroes rose to 2,756 for 1866–1870, 3,401 for 1871–1875, 3,491 for

TABLE 134.—*Number of deaths and rate of death, per 100,000 living inhabitants, from all causes, by color and sex, from 1878 to 1920, inclusive.*

D = death. R = rate.

Year.	White.				Colored.				Year.	White.				Colored.			
	Male.		Fem.		Male.		Fem.			Male.		Fem.		Male.		Fem.	
	D	R	D	R	D	R	D	R		D	R	D	R	D	R	D	R
1878	2556	1924	2603	1834	716	3376	858	2975	1900	4179	2012	3914	1767	1251	3606	1356	3149
1879	2970	2190	2913	2010	851	3921	884	3011	1901	4095	1943	3761	1678	1336	3788	1287	2947
1880	3180	2297	2990	2020	888	3998	985	3295	1902	4072	1905	3661	1614	1274	3553	1246	2814
1881	3402	2407	3317	2195	1008	4436	1089	3579	1903	4027	1858	3632	1583	1214	3331	1268	2825
1882	3607	2501	3273	2122	1007	4332	1038	3352	1904	4271	1944	3825	1649	1383	3734	1339	2944
1883	3659	2486	3466	2202	1078	4535	1177	3734	1905	4202	1888	3737	1594	1363	3622	1393	3022
1884	3340	2225	3058	1905	906	3727	989	3083	1906	4308	1911	3725	1573	1355	3544	1365	2923
1885	3211	2097	3113	1901	878	3532	951	2914	1907	4429	1940	3949	1651	1422	3663	1390	2939
1886	3283	2103	3194	1912	870	3424	992	2988	1908	4144	1793	3730	1544	1317	3341	1244	2598
1887	3250	2042	3130	1838	942	3627	1050	3109	1909	4073	1742	3718	1525	1321	3302	1264	2607
1888	3578	2102	3316	1786	988	3540	1054	2944	1910	4236	1791	3910	1589	1352	3330	1255	2557
1889	3436	1982	3383	1791	913	3209	971	2668	1911	4141	1731	3618	1458	1351	3279	1294	2606
1890	4112	2329	3914	2038	1047	3610	1125	3041	1912	4190	1732	3690	1474	1362	3259	1199	2386
1891	4055	2256	3783	1939	1065	3604	1170	3112	1913	4043	1653	3807	1509	1201	2834	1117	2197
1892	4301	2352	4060	2048	1105	3670	1116	2921	1914	4219	1708	3695	1453	1368	3183	1269	2468
1893	3741	2011	3629	1803	1105	3603	1079	2780	1915	3962	1587	3563	1390	1302	2989	1175	2260
1894	3731	1972	3511	1719	1087	3480	1157	2939	1916	4256	1688	3727	1444	1400	3171	1336	2542
1895	4069	2116	3815	1841	1213	3814	1204	3008	1917	4513	1773	3849	1481	1639	3663	1363	2566
1896	3956	2024	3656	1739	1140	3521	1167	2872	1918	6632	2581	5680	2170	1873	4132	1847	3441
1897	3760	1894	3403	1597	1091	3311	1075	2607	1919	4637	1509	4253	1373	1328	2774	1216	2156
1898	4102	2034	3806	1763	1218	3633	1259	3009	1920	4428	1436	4351	1374	1263	2371	1314	2368
1899	3982	1945	3782	1728	1187	3480	1201	2829									

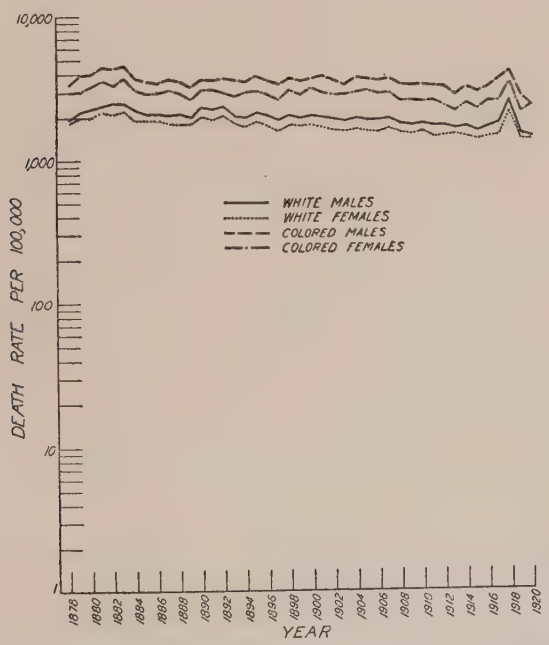
1876–1880, and 3,668 for 1881–1885. In the meantime, on its much lower level the rate for whites had been declining since 1875. For the 20 years between 1886 and 1905, the rate for negroes held nearly constant around 3,200, while the rate for whites was undergoing a considerable decline. For the quinquennium 1911–1915 the rate for negroes fell to 2,713, to rise to 2,893 for that ending in 1920. The period under consideration ends, then, with a rate for negroes higher than between 1841–1845, and 1856–1870.

Data for the study of the influence of sex in respect of race upon the mortality from all causes are available since 1878, and are represented in tables 134 and 135 and graph 37. During this period there has been a striking difference in favor of females. It will be observed that the rates for females have been uniformly lower than those for males, and it is notable that, with

the annual rates with a few exceptions and with the rates as averaged for 5-year periods without exception, the mortality for the two sexes in both races rose and fell together. Among whites, the difference between the rates

TABLE 135.—*Average rate of death, per 100,000 living inhabitants, by 5-year periods, from all causes, by color and sex, from 1878 to 1920, inclusive.*

Period.	White.		Colored.	
	Male.	Fem.	Male.	Fem.
1878-80	2137	1955	3765	3093
1881-85	2343	2065	4112	3332
1886-90	2112	1873	3482	2950
1891-95	2141	1870	3634	2952
1896-1900	1982	1719	3510	2893
1901-05	1908	1624	3606	2910
1906-10	1835	1576	3436	2725
1911-15	1722	1457	3109	2383
1916-20	1797	1568	3222	2615



GRAPH 37 (from table 134). Annual mortality-rates from all causes, by color and sex, from 1878 to 1920, inclusive.

for males and females was less marked before 1885 and after 1918 than in the intermediate period. Throughout the latter, especially when judged by the averaged rates, the difference between the level of the two rates is singularly uniform. Among negroes, except in a few years, notably 1878 and 1920,

when the rates for males and females approximated each other closely and in a few other years when they deviated somewhat more sharply than usual, the difference in mortality for the two sexes was very uniform.

Between 1814 and 1920, inclusive, and in unbroken series, the distribution of deaths according to the age of the decedents is recorded annually in the official records of the health department under the same age-groupings, 0 to 1, between 1 and 2, between 2 and 4, under 5, and between 5 and 9 years, and thereafter by decades of life. Deaths by age, sex, and color are recorded for 1910 and 1920. On account of the questionable accuracy of the estimated figures for these age-groups of the population in certain years (see chapter on population), the enormous amount of work involved in the necessary calculations, and the great expense of printing such voluminous tables, it is impracticable to present here mortality-rates specific for age for the inter-censal years. So important in some ways and so unique are these data that after studying rates specific for these age-groupings for the census years 1830 to 1920, they will be considered in their proportional relation to the whole number of annual deaths and such correspondences in the trends of these figures and the specific rates as may appear will be pointed out.

Rates specific for age for the whole population in the several census years 1830 to 1920, inclusive, are given in table 136 and graph 38. As the population figures for certain of the age-groups in 1830 and 1840, 1870, 1880, and 1890 were estimated (see table 10), the resulting rates must be regarded as only approximately correct. In regard to the first year of life, it will be observed that the rate rose somewhat gradually from 16,697 in 1850 to 28,640 in 1890, and then fell for each successive decennium to 13,197 in 1920. In the age-group 0 to 4 years the rate, after falling from 7,232 in 1830 to 5,891 in 1840, rose to a peak of 10,631 in 1870, and thereafter fell continuously to 4,107 in 1920. In order of sequence, the highest rates occurred in 1870, 1880, 1890, 1850, 1860, and 1830, and the lowest in 1840, 1910, and 1920. In the age-period 5 to 9 years the rate, after falling from 1,164 in 1830 to 836 in 1840, and reacting to 1,311 in 1850, fell to 911 in 1860, and then rising to its peak of 1,502 in 1880, by 1920 had declined to 313, a difference in the extremes even more striking than in the other two categories. In these age-groups, then, the rates fell significantly between 1830 and 1840, rose markedly between 1840 and 1870 or 1880, and declined in even greater degree between these dates and 1920. Consequently in the first decade of life, a like disproportion existed between the rates for 1840 and 1870 and between those of 1880 and 1920.

In the second decade of life, when, for each particular census year without exception the mortality was lightest, the rates stood in order of their high levels, 1850, 1870, 1860, 1830, and 1880, and their low levels, 1890, 1840, 1900, 1910, and 1920. Between 1850 and 1880, the recession was comparatively slight, while that between 1880 and 1920 was marked, and the declines for each succeeding decennium were in ever-increasing ratio. For the third decade of life the mortality was highest in 1850, 1830, 1870, 1880, and 1890, and lowest in 1840, 1900, 1910, and 1920. For the fourth decade the sequence of high rates according to years was 1830, 1850, 1840, 1870, 1890, 1880, 1860 and of the low rates 1900, 1910, and 1920. Whatever the changes among the others may have been, up to this age-group, 1900, 1910, and 1920, and,

TABLE 136.—*Number of deaths and rate of death, per 100,000 living inhabitants, from all causes, according to age for the census years 1830, 1840, 1850, 1860, 1870, 1880, 1890, and 1900, and according to age, sex, and color for 1910 and 1920.*

D = death. R = rate.

Age-groups.	1830		1840		1850		1860		1870		1880		1890		1900	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R	D	R
Under 1 year	406	....	532	....	1023	16697	1227	18813	2098	27806	2329	27227	2740	28640	2627	24225
Between 1 and 2 years	184	....	182	....	544	5600	616	4832	855	5836	701	4273	894	3771	525	5599
2 to 4 years	232	....	183	....	488		539		722		572		483		543	1792
0 to 4 years	822	7232	897	5891	2055	8369	2382	7830	3675	10631	3602	9394	4117	8934	3695	7814
5 to 9 years	110	1164	93	806	263	1311	234	911	301	982	541	1502	441	971	325	636
0 to 9 years	932	4478	990	3700	2318	5195	2616	4662	3976	6096	4143	5571	4558	4981	4020	3956
10 to 19 years	123	641	123	555	247	675	282	643	360	662	396	594	479	562	483	490
20 to 29 years	193	1129	205	909	399	1161	395	975	574	1099	663	998	843	960	916	904
30 to 39 years	202	1855	226	1517	381	1551	418	1311	562	1428	599	1249	834	1276	947	1187
40 to 49 years	214	3411	166	2085	278	1916	323	1562	500	1837	529	1498	784	1676	952	1639
50 to 59 years	126	3591	126	2838	220	2715	243	2155	443	2696	529	2280	804	2645	959	2648
60 to 69 years	85	4874	82	3600	157	3813	260	4783	385	4616	514	4203	1085	6440	1084	5231
70 to 79 years	57	6840	76	8889	134	8156	210	10314	278	8533	426	8667	498	7403	860	9574
80 years and over	42	10660	51	11778	86	13014	119	19070	184	20109	244	18813	313	10493	479	22094
Total	1974	2449	2045	1999	4210	2490	4866	2291	7262	2716	8043	2420	10198	2352	10700	2108

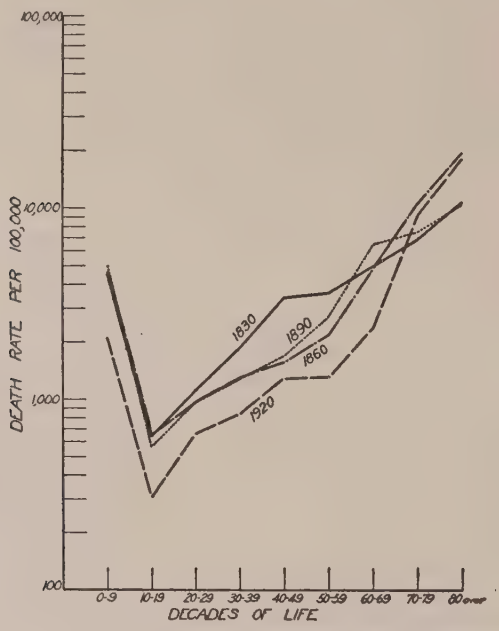
1910

Age-groups.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
Under 1 year	2148	20979	1566	17613	856	19069	710	16129	582	43175	356	51971	226	34087
Between 1 and 2 years	399	4151	304	3583	161	3672	143	3487	95	8429	52	9336	43	7544
2 to 4 years	344	1070	240	858	122	868	118	848	104	2503	54	2684	50	2333
0 to 4 years	2891	5561	2110	4652	1139	4966	971	4331	781	11780	462	14198	319	9449
5 to 9 years	188	379	146	338	73	337	73	339	42	654	15	490	27	804
0 to 9 years	3079	3030	2256	2548	1212	2717	1044	2376	823	6307	477	7555	346	5138
10 to 19 years	451	439	301	338	146	341	155	336	150	1089	62	1060	88	1111
20 to 29 years	883	781	570	617	289	650	281	586	313	1518	156	1725	157	1356
30 to 39 years	1010	1131	686	934	393	1105	293	773	324	2050	174	2275	150	1839
40 to 49 years	1094	1595	760	1329	420	1524	340	1147	334	2931	170	3006	164	2857
50 to 59 years	1256	2784	977	2502	553	2929	424	2102	279	4602	145	4899	134	4318
60 to 69 years	1352	5451	1138	5192	628	6354	510	4238	214	7410	100	7576	114	7270
70 to 79 years	1067	10208	976	10320	427	10843	549	9947	91	9137	45	11166	46	7757
80 years and over	561	21003	482	20295	168	19580	314	20699	79	26689	23	24731	56	27586
Total	10753	1925	8146	1721	4236	1851	3910	1599	2607	3064	1352	3433	1255	2745

1920

Age-groups.	Total.		White.						Colored.					
			Total.		Male.		Fem.		Total.		Male.		Fem.	
	D	R	D	R	D	R	D	R	D	R	D	R	D	R
Under 1 year	1960	13197	1490	11565	826	12515	664	10567	470	23882	258	26959	212	20969
Between 1 and 2 years	379	1253	270	1033	130	1031	140	1035	109	2903	56	2987	53	2823
2 to 4 years	304		227		119		108		77		37		40	
0 to 4 years	2643	4107	1987	3258	1075	3497	912	3016	656	7833	351	8624	305	7085
5 to 9 years	202	313	161	285	94	329	67	241	41	508	23	596	18	428
0 to 9 years	2845	2126	2148	1830	1169	1970	979	1686	697	4239	374	4716	323	3794
10 to 19 years	383	310	266	247	119	225	147	267	117	734	39	552	78	878
20 to 29 years	959	662	642	539	295	502	347	576	317	1227	147	1206	170	1246
30 to 39 years	1030	842	693	689	368	730	325	648	337	1544	168	1520	169	1570
40 to 49 years	1174	1271	809	1054	416	1089	393	1019	365	2343	182	2197	183	2510
50 to 59 years	1448	2314	1110	2029	601	2252	509	1816	338	4301	161	3793	177	4899
60 to 69 years	1569	4357	1321	4059	704	4600	617	3580	248	7157	115	6713	133	7591
70 to 79 years	1325	9192	1216	9312	551	9845	665	8913	109	8038	57	9421	52	6924
80 years and over	623	17902	574	18362	205	18255	369	18422	49	13842	20	14925	29	13182
Total	11356	1548	8780	1405	4429	1436	4351	1373	2577	2371	1263	2372	1314	2369

through the first three decades of life, 1840, held steadily the same relative positions as years of low rates and invariably registered the lowest mortality. With the fifth decade of life there began a notable rearrangement, through which, finally, with advancing age, though in rather irregular progression, relative to each other the rates in the earlier census years fell and those in the latter rose to high levels. In consequence, it appears as a general law that when the force of mortality was strongest in the first four decades it generally weakened during the remainder of life, and, conversely, that when this force was relatively less vigorous in early life, it gained in strength proportionately after middle life.



GRAPH 38 (from table 136). Mortality-rates from all causes, specific for age in the whole population, for the census years 1830, 1850, 1900 and 1920.

From table 136 and graph 38 it is very evident that the rate for the age-group below the tenth year, which during the whole period until after 1910 carried the highest mortality of any decade of life under the sixth, rose on the whole between 1830 and 1870 and thereafter declined continuously. For the second half of this age-group, namely, from 5 to 9 years, the mortality-rate, after fluctuating rather widely between 1830 and 1860 and during these 30 years following closely that for the third decade of life, rose abruptly from 1860 to 1880, when it surpassed that for the fifth decade. After 1880 it fell sharply, and by 1920 it was but little higher than that for the second decade of life. The rate for the first demi-decade, 0 to 4 years, higher between 1870 and 1890 than that for the eighth decade of life, declined markedly after 1870. For the first year of life the rate rose slightly between 1850 and 1860, sharply between 1860 and 1870, reached its peak in 1890 and fell gradually until

1910 and conspicuously between 1910 and 1920. Except for the slight drop between 1830 and 1840, the mortality-rates for the second and third decades showed but little change from 1830 to 1890, but between the latter date and 1920 the fall was considerable in each case. In the fourth decade the death-rate fell notably from 1830 to 1860, but for the next 30 years it ran an almost level course; with but a slight drop between 1890 and 1910, in the last 10 years there was a conspicuous decline. In the fifth decade the rate declined considerably, and but for a reaction in 1870, steadily, from 1830 to 1880; rising in 1890 to a level higher than in 1860, and remaining almost stationary for the next 30 years, the rate fell to its lowest point in 1920. For the sixth decade the mortality-rate fell in considerable degree from 1830 to 1860, but from the latter date, except for a decline in 1870, the trend was continuously upwards during the succeeding 50 years, and by 1910 the rate was higher than in 1850. The slight decline between 1910 and 1920 failed to lower the rate to the level of 1860. The course of the rate of the seventh decade was characterized by great instability. Falling markedly from 1830 to 1840 and then rising by 1860 to near the level of 1830, it again declined until 1880. Reaching a high peak in 1890, by 1920 it had fallen to a level but slightly higher than that obtaining in 1880. For the age-groups over 70 years the mortality-rates, while pursuing a somewhat irregular course, were considerably higher in 1920 than in 1830. It is noteworthy that between 1910 and 1920 every age-group and between 1830 and 1840 all, but the two highest, showed distinct declines.

On the whole, during the 90 years between 1830 and 1920, the several age-groups above the fiftieth year exhibited no fall in mortality. In extreme old age the trend of mortality was distinctly upward. In all of the age-groups below the fiftieth year decided declines occurred. Among the latter, except for age-group 40 to 49 years, all substantial recessions in mortality have taken place since 1870. This phenomenon is well illustrated by a comparison of the courses of the rates in the various census years for the population above and below the fortieth year of life with those for the whole population. This is done in table 137. Here the determining influence of the decline in mortality under the fortieth year upon that for all ages since 1870 is brought out very clearly. The failure of any decline in the force of mortality in the remainder of the population is equally evident. As in the natural order all must die, no considerable decrease in the rate of death for the age-groups above the fortieth year can be predicated; but the point here made clear is that between 1830 and 1920 for this age-group as a whole there was no extension, but rather a decline in the duration of life, and for the age-group below the fortieth year, while no decline in the death-rate occurred between 1830 and 1870, since the latter date it has fallen by nearly 60 per cent.

Data for the calculation of rates specific for age, color, and sex are available for 1910 and 1920 (table 136). In 1910, when among both whites and negroes the rates for males was considerably higher than for females, the mortality was greater among whites for males than for females in all the age-groups except 5 to 9 and 80 years and over, and among negroes in males for every age-group except 5 to 9, 10 to 19, and 80 years and over. This excess of male mortality was particularly marked in the whites in the first, fifth, sixth, and seventh, and in negroes in the first, third, and eighth decades of life. In 1920,

when the differences between the rates for all ages in the two sexes of both races was comparatively slight, the rates were higher in males than in females in all the age-groups among whites, except in the third decade and 80 years and over, and among negroes in females than in males except the first and eighth decades and 80 years and over. In both years mortality was higher in negroes than in whites in all age-groups except in the eighth decade. This difference in favor of the white was greatest below the fiftieth year of life, and in the earlier age-groups amounted to from 100 to 150 per cent. In every

TABLE 137.—*Number of deaths and rate of death, per 100,000 living inhabitants, specific for the total number, those under 40 years of age, and those 40 years of age and over, for the decennia 1830 to 1920, inclusive.**

Decennia.	Total.		Under 40 years.		40 years and over.	
	D	R	D	R	D	R
1830	1967	2440	1454	2139	513	2265
1840	2184	2135	1675	1940	509	3188
1850	4181	2473	3264	2329	917	3167
1860	4776	2248	3669	2129	1107	2764
1870	6970	2607	5281	2501	1689	3008
1880	8159	2455	5904	2312	2255	2930
1890	9658	2228	6235	1890	3423	3300
1900	10443	2058	6041	1584	4402	3489
1910	10511	1884	5363	1320	5148	3395
1920	11395	1553	5305	1011	6090	2917

* The number of deaths for each decennium is a 3-year average of that obtaining in the decennial year and in those years immediately preceding and following, except in 1920 when the average is for 1919 and 1920 only.

age-group the mortality was greater for negro males than for white males and females, and for negro females than for white males, except in the eighth decade, and for white females except in the age-period 80 years and over in 1920.

The proportional distribution of deaths at different ages to the total deaths at all ages for each year from 1814 to 1920 will now be studied. The number of deaths for each of these age-groups and their ratio per hundred to the total deaths at all ages are given for individual years in table 138 and as averaged for 5- and 10-year periods in table 139. In addition, in these tables are presented the number and proportion of deaths recorded as occurring under (before) the fifth and tenth, twentieth, thirtieth, fortieth, fiftieth, sixtieth, and seventieth years of life, and 70 years and over. In the consideration of this material it is necessary to bear constantly in mind exactly what it does and does not represent, for otherwise conclusions open to serious errors may be drawn. The figures in the percentages columns indicate solely the proportion in any given period of time of all the decedents of all ages that fell within certain age-groups. The number of living individuals in the population subject to the risk of death was never, of course, evenly distributed in respect to age-groupings, and the proportional distribution of living individ-

TABLE 138.—*Percentage, by separate years, of deaths by specified age-periods of total deaths from all causes, from 1814 to 1920, inclusive.*

Year.	Under 1 year.		Between 1 and 2 years.		Under 2 years.		2 to 4 years.		Under 5 years.		5 to 9 years.		Under 10 years.		10 to 19 years.		20 to 29 years.		30 to 39 years.	
	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.
1814 ..	249	21.6	115	10.0	364	31.6	70	6.1	434	37.7	41	3.6	475	41.2	76	6.6	179	15.5	167	14.5
1815 ..	448	33.2	73	5.4	521	38.6	92	6.8	613	45.4	70	5.2	683	50.6	192	14.2	174	12.9	107	7.9
1816 ..	477	36.2	73	5.5	550	41.8	104	7.9	654	49.7	54	4.1	708	53.8	166	12.6	176	13.4	102	7.7
1817 ..	430	32.5	141	10.7	571	43.1	59	4.5	630	47.6	39	3.0	669	50.5	108	8.2	198	15.0	133	10.1
1818 ..	499	29.1	190	11.1	689	40.2	53	3.1	742	43.2	62	3.6	804	46.9	154	9.0	251	14.6	210	12.2
1819 ..	516	23.7	252	11.6	768	35.2	129	5.9	897	41.1	147	6.7	1044	47.9	291	13.3	357	16.4	191	8.8
1820 ..	390	25.5	116	7.6	506	33.1	48	3.1	554	36.3	77	5.0	631	41.3	113	7.4	177	11.6	210	13.8
1821 ..	323	16.9	134	7.0	457	23.9	116	6.1	573	30.0	87	4.6	660	34.6	170	8.9	247	12.9	283	14.8
1822 ..	347	15.8	154	7.0	501	22.8	114	5.2	615	28.0	91	4.1	706	32.1	232	10.6	325	14.8	341	15.5
1823 ..	366	18.3	200	10.0	566	28.3	253	12.7	819	41.0	116	5.8	935	46.8	149	7.5	174	8.7	236	11.8
1824 ..	310	22.7	78	5.7	388	28.4	106	7.8	494	36.2	57	4.2	551	40.3	112	8.2	139	10.2	164	12.0
1825 ..	316	21.8	114	7.9	430	29.6	103	7.1	533	36.7	54	3.7	587	40.4	94	6.5	170	11.7	190	13.1
1826 ..	412	22.6	171	9.4	583	32.0	138	7.6	721	39.5	71	3.9	792	43.4	117	6.4	178	9.8	230	12.6
1827 ..	360	25.8	100	7.2	460	32.9	102	7.3	562	40.2	59	4.2	621	44.4	94	6.7	133	9.5	167	12.0
1828 ..	435	27.0	134	8.3	569	35.3	149	9.2	718	44.5	53	3.3	771	47.8	87	5.4	152	9.4	156	9.7
1829 ..	428	24.6	126	7.2	554	31.8	167	9.6	721	41.4	55	3.2	776	44.5	111	6.4	177	10.2	188	10.8
1830 ..	406	20.6	184	9.3	590	29.9	232	11.8	822	41.6	110	5.6	932	47.2	123	6.2	193	9.8	202	10.2
1831 ..	514	23.5	166	7.6	680	31.1	244	11.2	924	42.3	125	5.7	1049	48.0	147	6.7	225	10.3	248	11.4
1832 ..	652	19.0	222	6.5	874	25.5	241	7.0	1115	32.5	117	3.4	1232	36.0	240	7.0	409	11.9	507	14.8
1833 ..	625	27.4	224	9.8	849	37.3	274	12.0	1123	49.3	124	5.4	1247	54.7	136	6.0	213	9.4	228	10.0
1834 ..	616	23.7	240	9.2	856	32.9	267	10.3	1123	43.2	117	4.5	1240	47.7	172	6.6	289	11.1	299	11.5
1835 ..	461	24.3	176	9.3	637	33.6	141	7.4	778	41.0	58	3.1	836	44.1	120	6.3	189	10.0	223	11.8
1836 ..	584	26.6	180	8.2	764	34.9	208	9.5	972	44.3	78	3.6	1050	47.9	109	5.0	203	9.3	227	10.4
1837 ..	630	25.0	275	10.9	905	35.9	324	12.9	1229	48.8	148	5.9	1377	54.7	172	6.8	217	8.6	250	9.9
1838 ..	655	26.5	256	10.3	911	36.8	246	9.9	1157	46.7	125	5.1	1282	51.8	154	6.2	238	9.6	276	11.2
1839 ..	612	27.1	257	11.4	869	38.5	266	11.8	1135	50.2	99	4.4	1234	54.6	112	5.0	189	8.4	220	9.7
1840 ..	532	26.0	182	8.9	714	34.9	183	9.0	897	43.9	93	4.6	990	48.4	123	6.0	205	10.0	226	11.1
1841 ..	651	29.0	217	9.7	868	38.6	208	9.3	1076	47.9	82	3.7	1158	51.5	123	5.5	214	95	231	10.3
1842 ..	666	26.9	315	12.7	981	39.6	263	10.6	1244	50.2	106	4.3	1350	54.5	158	6.4	225	9.1	221	8.9
1843 ..	682	29.2	229	9.8	911	39.0	153	6.6	1064	45.6	91	3.9	1155	49.5	138	5.9	251	10.8	234	10.0
1844 ..	630	23.6	285	10.7	915	34.3	363	13.6	1278	48.0	158	5.9	1436	53.9	161	6.0	212	8.0	262	9.8
1845 ..	830	28.7	208	7.2	1038	35.8	351	12.1	1389	48.0	149	5.2	1538	53.1	155	5.4	283	9.8	305	10.5
1846 ..	786	26.3	287	9.6	1073	35.8	320	10.7	1393	46.5	167	5.6	1560	52.1	200	6.7	262	8.8	305	10.2
1847 ..	866	25.4	420	12.3	1286	37.7	376	11.0	1662	48.7	173	5.1	1835	53.8	151	4.4	320	9.4	343	10.1
1848 ..	959	24.8	471	12.2	1430	37.0	508	13.2	1938	50.2	220	5.7	2158	55.9	207	5.4	352	9.1	349	9.0
1849 ..	995	23.9	500	12.0	1495	35.9	414	9.9	1909	45.8	174	4.2	2083	50.0	237	5.7	435	10.4	433	10.4
1850 ..	1023	24.3	544	12.9	1567	37.2	488	11.6	2055	48.8	263	6.3	2318	55.1	247	5.9	399	9.5	381	9.1
1851 ..	1039	24.9	496	11.9	1535	36.8	467	11.2	2002	48.0	233	5.6	2235	53.6	206	4.9	429	10.3	391	9.4
1852 ..	1203	24.2	667	13.4	1870	37.7	683	13.8	2553	51.4	315	6.3	2868	57.8	262	5.3	450	9.1	394	7.9
1853 ..	1173	24.4	478	10.0	1651	34.4	595	12.4	2246	46.8	287	6.0	2533	52.7	270	5.6	457	9.5	488	10.2
1854 ..	1235	23.1	656	12.3	1891	35.4	676	12.7	2567	48.0	312	5.8	2879	53.9	284	5.3	532	10.0	535	10.0
1855 ..	1306	25.7	647	12.8	1953	38.5	500	9.9	2453	48.3	249	4.9	2702	53.2	286	5.6	484	9.5	462	9.1
1856 ..	1471	28.1	758	14.5	2229	42.6	528	10.1	2757	52.7	229	4.4	2986	57.1	191	3.7	458	8.8	497	9.5
1857 ..	1316	25.7	713	13.9	2029	39.6	627	12.2	2656	51.9	319	6.2	2975	58.1	244	4.8	411	8.0	405	7.9
1858 ..	1283	23.7	738	13.7	2021	37.4	734	13.6	2755	51.0	388	7.2	3143	58.1	273	5.1	440	8.1	424	7.8
1859 ..	1197	25.6	653	14.0	1850	39.6	553	11.8	2403	51.4	284	6.1	2687	57.5	241	5.2	354	7.6	393	8.4
1860 ..	1227	25.2	616	12.7	1843	37.9	539	11.1	2382	49.0	234	4.8	2616	53.8	282	5.8	395	8.1	418	8.6
1861 ..	1178	24.6	607	12.7	1785	37.3	515	10.8	2300	48.0	278	5.8	2578	53.8	224	4.7	420	8.8	399	8.3
1862 ..	1105	21.4	605	11.7	1710	33.1	757	14.6	2467	47.7	440	8.5	2907	56.2	278	5.4	394	7.6	390	7.5
1863 ..	1180	21.3	545	9.8	1725	31.1	814	14.7	2539	45.7	413	7.4	2952	53.2	315	5.7	494	8.9	491	8.9
1864 ..	1270	22.4	623	11.0	1893	33.3	840	14.8	2733	48.1	376	6.6	3109	54.8	333	5.9	478	8.4	479	8.4
1865 ..	1083	23.1	384	8.2	1467	31.3	615	13.1	2082	44.4	263	5.6	2345	50.0	269	5.7	518	11.0	397	8.5
1866 ..	1285	22.9	587	10.4	1872	33.3	594	10.6	2466	43.9	294	5.2	2760	49.1	369	6.6	537	9.6	487	8.7
1867 ..	1262	23.9	568	10.8	1830	34.6	622	11.8	2452	46.4	225	4.3	2677	50.7	226	4.3	519	9.8	469	8.9
1868 ..	1615	26.1	778	12.6	2393	38.7	747	12.1	3140	50.8	295	4.8	3435	55.6	241	3.9	523	8.5	505	8.2
1869 ..	1710	26.3	776	11.9	2486	38.3	753	11.6	3239	49.9	345	5.3	3584	55.2	276	4.3	593	9.1	490	7.5
1870 ..	2098	28.9	855	11.8	2953	40.7	722	9.9	3675	50.6	301	4.1	3976	54.7	360	5.0	574	7.9	562	7.7
1871 ..	1714	24.0	892	12.5	2606	36.5	850	11.9	3456	48.4	438	6.1	3894	54.5	414	5.8	577	8.1	543	7.6
1872 ..	2090	23.6	1067	12.1	3157	35.7	1020	11.5	4177	47.2	566	6.4	4743	53.6	533	6.0	843	9.5	698	7.9
1873 ..	1923	25.3	759	10.0	2682	35.3	611	8.1	3293	43.4	369	4.9	3662	48.3	561	7.4	679	9.0	651	8.6
1874 ..	2090	28.3	857	11.6	2947	39.9	577	7.8	3524	47.8	315	4.3	3839	52.0	435	5.9	643	8.7	560	7.6
1875 ..	2216	30.5	705	9.7	2921	40.2	508	7.0	3429	47.2	373	5.1	3802	52.4	378	5.2	609	8.4	560	7.7
1876 ..	2317	30.9	925	12.3	3242	43.2	398	5.3	3640	48.6	424	5.7	4064	54.2	407	5.4	627	8.4	528	7.0
1877 ..	2182	27.6	1329	16.8	3511	44.4	518	6.6	4029	50.9	560	7.1	4589	58.0	423	5.4	579	7.3	526	6.7
1878 ..	1834	27.2	604	9.0	2438	36.2	444	6.6	2882	42.8	364	5.4	3246	48.2	356	5.3	596	8.9	560	8.3
1879 ..	2066	27.1	762	10.0	2828	37.1	557	7.3	3385	44.4	558	7.3	3943	51.8	347	4.6	644	8.5	559	7.3
1880 ..	2329	29.0	701	8.7	3030	37.7	572	7.1	3602	44.8	541	6.7	4143	51.5	396	4.9	663	8.2	599	7.5
1881 ..	2364	26.8	864	9.8	3228	36.6	691	7.8	3919	44.5	665	7.5	4584	52.0	444	5.0	743	8.4	647	7.3
1882 ..	2198	24.6	844	9.5	3042	34.1	713	8.0	3755	42.1	800	9.0	4555	51.0	418	4.7	767	8.6	667	7.5
1883 ..	2351	25.1	881	9.4	3232	34.5	830	8.9	4062	43.3	796	8.5	4858	51.8	480	5.1	811	9.7	746	8.0
1884 ..	2354	28.4	783	9.4	3137	37.8	506	6.1	3643	43.9	472	5.7	4115	50.0	377	4.6	755	9.1	633	7.6
1885 ..	2196	26.9	650	8.0	2846	34.9	382	4.7	3228	39.6	363	4.4	3591	44.0	381	4.7	808	9.9	698	8.6
1886 ..	2393	28.7	760	9.1	3153	37.8	412	4.9	3565	42.8	347	4.2	3912	47.0	400	4.8	736	8.8	720	8.6
1887 ..	2420	28.9	685	8.2	3105	37.1	372	4.4	3477	41.5	307	3.7	3784	45.2	370	4.4	702	8.4	708	8.5
1888 ..	2624	29.4	787	8.8	3411	38.2	470	5.3	3881	43.4	345	3.9	4226	47.3	385	4.3	742	8.3	715	8.0
1889 ..	2578	29.6	614	7.1	3192	36.7	313	3.6	3505	40.3	321	3.7	3826	44.0	432	5.0	766	8.8	720	8.3
1890 ..	2740	26.9	894	8.8	3634	35.6	483	4.7	4117	40.4	441	4.3	4558	44.7	479	4.7	843	8.3	834	8.2

TABLE 138.—*Percentage, by separate years, of deaths by specified age-periods of total deaths from all causes, from 1814 to 1920, inclusive.*—Continued.

Year.	Under 1 year.		Between 1 and 2 years.		Under 2 years.		2 to 4 years.		Under 5 years.		5 to 9 years.		Under 10 years.		10 to 19 years.		20 to 29 years.		30 to 39 years.	
	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of deaths.	Deaths.	Per cent of deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.
1891 ..	2632	26.1	732	7.3	3364	33.4	546	5.4	3910	38.8	401	4.0	4311	42.8	445	4.4	746	7.4	746	7.4
1892 ..	2834	26.8	886	8.4	3720	35.2	723	6.8	4443	42.0	436	4.1	4879	46.1	464	4.4	847	8.0	816	7.7
1893 ..	2613	27.4	585	6.1	3198	33.5	406	4.3	3604	37.7	257	2.7	3861	40.4	505	5.3	782	8.2	784	8.2
1894 ..	2616	27.6	669	7.1	3285	34.6	476	5.0	3761	39.7	255	2.7	4016	42.3	459	4.8	778	8.2	780	8.2
1895 ..	2734	26.5	739	7.2	3473	33.7	553	5.4	4026	39.1	282	2.7	4308	41.8	480	4.7	775	7.5	848	8.2
1896 ..	2565	25.9	633	6.4	3198	32.2	530	5.3	3728	37.6	276	2.8	4004	40.4	452	4.6	831	8.4	828	8.4
1897 ..	2478	26.6	546	5.9	3024	32.4	486	5.2	3510	37.6	340	3.6	3850	41.3	430	4.6	694	7.4	823	8.8
1898 ..	2724	26.2	580	5.6	3304	31.8	635	6.1	3939	37.9	363	3.5	4302	41.4	479	4.6	853	8.2	809	7.8
1899 ..	2433	24.0	409	4.0	2842	28.0	477	4.7	3319	32.7	299	3.0	3618	35.6	510	5.0	886	8.7	907	8.9
1900 ..	2627	24.6	525	4.9	3152	29.5	543	5.1	3695	34.5	325	3.0	4020	37.6	483	4.5	916	8.6	947	8.9
1901 ..	2544	24.3	449	4.3	2993	28.6	398	3.8	3391	32.4	213	2.0	3604	34.4	422	4.0	942	9.0	991	9.5
1902 ..	2449	23.9	466	4.6	2915	28.4	412	4.0	3327	32.5	233	2.3	3560	34.7	453	4.4	922	9.0	894	8.7
1903 ..	2174	21.4	457	4.5	2631	26.0	471	4.6	3102	30.6	260	2.6	3362	33.2	475	4.7	867	8.6	920	9.1
1904 ..	2289	21.2	448	4.1	2737	25.3	418	3.9	3155	29.2	257	2.4	3412	31.5	488	4.5	987	9.1	986	9.1
1905 ..	2457	23.0	531	5.0	2988	27.9	477	4.5	3465	32.4	202	1.9	3667	34.3	436	4.1	942	8.8	975	9.1
1906 ..	2418	22.5	518	4.8	2936	27.3	383	3.6	3319	30.9	228	2.1	3547	33.0	466	4.3	957	8.9	977	9.1
1907 ..	2423	21.7	542	4.8	2965	26.5	368	3.3	3333	29.8	206	1.8	3539	31.6	438	3.9	1002	9.0	1106	9.9
1908 ..	2215	21.2	412	4.0	2627	25.2	340	3.3	2967	28.4	222	2.1	3189	30.6	441	4.2	910	8.7	960	9.2
1909 ..	2227	21.5	474	4.6	2701	26.0	370	3.6	3071	29.6	225	2.2	3296	31.8	390	3.8	915	8.8	933	9.0
1910 ..	2148	20.0	399	3.7	2547	23.7	344	3.2	2891	26.9	188	1.8	3079	28.6	451	4.2	883	8.2	1010	9.4
1911 ..	1958	18.8	425	4.1	2383	22.9	331	3.2	2714	26.1	205	2.0	2919	28.1	402	3.9	880	8.5	933	9.0
1912 ..	2026	19.4	361	3.5	2387	22.9	336	3.2	2723	26.1	171	1.6	2894	27.7	354	3.4	877	8.4	992	9.5
1913 ..	2002	19.7	399	3.9	2401	23.6	331	3.3	2732	26.9	210	2.1	2942	28.9	327	3.2	844	8.3	925	9.1
1914 ..	1954	18.5	394	3.7	2348	22.3	284	2.7	2632	24.9	192	1.8	2824	26.8	351	3.3	840	8.0	939	8.9
1915 ..	1633	16.3	300	3.0	1933	19.3	248	2.5	2181	21.8	162	1.6	2343	23.4	354	3.5	765	7.7	945	9.5
1916 ..	1783	16.6	367	3.4	2150	20.1	305	2.9	2455	22.9	195	1.8	2650	24.7	359	3.4	815	7.6	972	9.1
1917 ..	1783	15.7	358	3.2	2141	18.8	305	2.7	2446	21.5	220	1.9	2666	23.5	427	3.8	910	8.0	1120	9.9
1918 ..	2259	14.1	766	4.8	3025	18.9	621	3.9	3646	22.7	365	2.3	4011	25.0	818	5.1	2288	14.3	2034	12.7
1919 ..	1711	15.0	350	3.1	2061	18.0	418	3.7	2479	21.7	227	2.0	2706	23.7	459	4.0	1058	9.3	1170	10.2
1920 ..	1960	17.3	379	3.3	2339	20.6	304	2.7	2643	23.3	202	1.8	2845	25.1	383	3.4	959	8.4	1030	9.1

Year.	Under 40 years.		40 to 49 years.		Under 50 years.		50 to 59 years.		60 to 69 years.		70 to 79 years.		80 to 89 years.		90 to 99 years.		100 years and over.		Unknown age.	
	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.
1814 ..	897	77.9	115	10.0	1012	87.9	49	4.3	29	2.5	35	3.0	25	2.2	2	0.2	....	....	....	....
1815 ..	1156	85.7	58	4.3	1214	90.0	47	3.5	37	2.7	37	2.7	8	0.6	5	0.4	1	0.1	....	....
1816 ..	1152	87.5	53	4.0	1205	91.5	41	3.1	26	2.0	37	2.8	5	0.4	2	0.2	1	0.1	....	....
1817 ..	1108	83.7	90	6.8	1198	90.5	39	3.0	24	1.8	34	2.6	23	1.7	4	0.3	2	0.2	....	....
1818 ..	1419	82.7	107	6.2	1526	88.9	69	4.0	43	2.5	37	2.2	26	1.5	13	0.8	2	0.1	....	....
1819 ..	1883	86.3	117	5.4	2000	91.7	71	3.3	39	1.8	35	1.6	27	1.2	9	0.4	1	0.1	....	....
1820 ..	1131	74.1	133	8.7	1264	82.8	107	7.0	62	4.1	35	2.3	47	3.1	9	0.6	3	0.2	....	....
1821 ..	1360	71.2	228	11.9	1588	83.1	134	7.0	83	4.4	48	2.5	37	1.9	15	0.8	5	0.3	....	....
1822 ..	1604	73.0	239	10.9	1843	83.9	153	7.0	90	4.1	63	2.9	39	1.8	6	0.3	4	0.2	....	....
1823 ..	1494	74.7	206	10.3	1700	85.0	131	6.6	82	4.1	52	2.6	28	1.4	6	0.3	1	0.1	....	....
1824 ..	966	70.7	152	11.1	1118	81.9	79	5.8	74	5.4	56	4.1	29	2.1	7	0.5	3	0.2	....	....
1825 ..	1041	71.7	139	9.6	1180	81.2	101	7.0	80	5.5	58	4.0	23	1.6	9	0.6	2	0.1	....	....
1826 ..	1317	72.2	178	9.8	1495	81.9	131	7.2	88	4.8	59	3.2	41	2.3	9	0.5	2	0.1	....	....
1827 ..	1015	72.6	131	9.4	1146	82.0	110	7.9	56	4.0	49	3.5	28	2.0	8	0.6	1	0.1	....	....
1828 ..	1166	72.3	155	9.6	1321	82.0	106	6.6	83	5.2	51	3.2	40	2.5	7	0.4	4	0.3	....	....
1829 ..	1252	71.8	176	10.1	1428	81.9	122	7.0	87	5.0	65	3.7	32	1.8	6	0.3	3	0.2	....	....
1830 ..	1450	73.5	214	10.8	1664	84.3	126	6.4	85	4.3	57	2.9	34	1.7	4	0.2	4	0.2	....	....
1831 ..	1669	76.4	179	8.2	1848	84.6	118	5.4	103	4.7	64	2.9	41	1.9	6	0.3	5	0.2	....	....
1832 ..	2388	69.7	386	11.3	2774	80.9	253	7.4	194	5.7	119	3.5	63	1.8	16	0.5	8	0.2	....	....
1833 ..	1824	80.0	158	6.9	1982	87.0	107	4.7	93	4.1	58	2.5	30	1.3	6	0.3	3	0.1	....	....
1834 ..	2000	76.9	217	8.4	2217	85.3	144	5.5	102	3.9	77	3.0	44	1.7	10	0.4	6	0.2	....	....
1835 ..	1368	72.2	196	10.3	1564	82.5	122	6.4	81	4.3	76	4.0	39	2.1	8	0.4	6	0.3	....	....
1836 ..	1589	72.5	191	8.7	1780	81.2	147	6.7	124	5.7	81	3.7	41	1.9	11	0.5	8	0.4	....	....
1837 ..	2016	80.1	162	6.4	2178	86.5	103	4.1	115	4.6	80	3.2	35	1.4	6	0.2	1	0.4	....	....
1838 ..	1950	78.8	188	7.6	2138	86.4	124	5.0	98	4.0	61	2.5	44	1.8	8	0.3	3	0.1	....	....
1839 ..	1755	77.7	148	6.6	1903	84.2	116	5.1	97	4.3	88	3.9	45	2.0	9	0.4	2	0.1	....	....
1840 ..	1544	75.5	166	8.1	1710	83.6	126	6.2	82	4.0	76	3.7	44	2.2	5	0.2	2	0.1	....	....
1841 ..	1726	76.8	165	7.3	1891	84.2	120	5.3	107	4.8	73	3.3	45	2.0	8	0.4	3	0.1	....	....
1842 ..	1954	78.9	190	7.7	2144	86.6	109	4.4	93	3.8	66	2.7	49	2.0	10	0.4	6	0.2	....	....
1843 ..	1778	76.2	166	7.1	1944	83.3	112	4.8	132	5.7	94	4.0	42	1.8	9	0.4	2	0.1	....	....
1844 ..	2071	77.7	222	8.3	2293	86.0	126	4.7	110	4.1	72	2.7	42	1.6	13	0.5	9	0.3	....	....
1845 ..	2281	78.8	228	7.9	2509	86.6	144	5.0	115	4.0	71	2.5	37	1.3	14	0.5	6	0.2	....	....

TABLE 138.—*Percentage, by separate years, of deaths by specified age-periods of total deaths from all causes, from 1814 to 1920, inclusive.*—Continued.

Year.	Under 40 years.		40 to 49 years.		Under 50 years.		50 to 59 years.		60 to 69 years.		70 to 79 years.		80 to 89 years.		90 to 99 years.		100 years and over.		Unknown age.	
	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.	Deaths.	Per cent of total deaths.
1846 ..	2327	77.7	232	7.8	2559	85.5	135	4.5	129	4.3	94	3.1	59	2.0	15	0.5	3	0.1	.....	.....
1847 ..	2649	77.6	259	7.6	2908	85.2	176	5.2	124	3.6	133	3.9	57	2.0	12	0.4	4	0.1	.....	.....
1848 ..	3066	79.4	261	6.8	3327	86.2	174	4.5	152	3.9	128	3.3	57	1.5	17	0.4	6	0.2	.....	.....
1849 ..	3188	76.5	336	8.1	3524	84.6	195	4.7	207	5.0	152	3.7	59	1.4	21	0.5	7	0 2	.....	.....
1850 ..	3345	79.5	278	6.6	3623	86.1	220	5.2	157	3.7	134	3.2	59	1.4	13	0.3	4	0.1	.....	.....
1851 ..	3261	78.2	315	7.6	3576	85.8	189	4.5	176	4.2	166	4.0	49	1.2	10	0.2	3	0.1	.....	.....
1852 ..	3974	80.0	339	6.8	4313	86.9	215	4.3	202	4.1	144	2.9	66	1.3	19	0.4	6	0.1	.....	.....
1853 ..	3748	78.0	357	7.4	4105	85.5	221	4.6	228	4.8	146	3.0	79	1.6	21	0.4	3	0.1	.....	.....
1854 ..	4230	79.2	386	7.2	4616	86.4	253	4.7	237	4.4	143	2.7	65	1.2	17	0.3	12	0.2	.....	.....
1855 ..	3934	77.5	356	7.0	4290	84.5	281	5.5	221	4.4	169	3.3	82	1.6	25	0.5	7	0.1	.....	.....
1856 ..	4132	79.0	359	6.9	4491	85.9	225	4.3	222	4.3	183	3.5	86	1.6	15	0.3	7	0.1	.....	.....
1857 ..	4035	78.8	358	7.0	4393	85.8	235	4.6	225	4.4	163	3.2	73	1.4	23	0.5	8	0.2	.....	.....
1858 ..	4280	79.2	346	6.4	4626	85.6	220	4.1	261	4.8	173	3.2	100	1.9	22	0.4	5	0.1	.....	.....
1859 ..	3675	78.6	298	6.4	3973	85.0	226	4.8	220	4.7	153	3.3	73	1.6	23	0.5	6	0.1	.....	.....
1860 ..	3711	76.3	323	6.6	4034	82.9	243	5.0	260	5.3	210	4.3	106	2.2	9	0.2	4	0.1	.....	.....
1861 ..	3621	75.6	366	7.6	3987	83.2	251	5.2	244	5.1	192	4.0	95	2.0	14	0.3	7	0.2	.....	.....
1862 ..	3969	76.7	373	7.2	4342	83.9	264	5.1	252	4.9	185	3.6	92	1.8	29	0.6	9	0.2	.....	.....
1863 ..	4252	76.6	410	7.4	4662	84.0	268	4.8	286	5.2	202	3.6	107	1.9	17	0.3	9	0.2	.....	.....
1864 ..	4399	77.5	401	7.1	4800	84.5	282	5.0	263	4.6	204	3.6	101	1.8	22	0.4	6	0.1	.....	.....
1865 ..	3529	75.2	327	7.0	3856	82.1	275	5.9	267	5.7	179	3.8	85	1.8	27	0.6	6	0.1	.....	.....
1866 ..	4153	73.9	429	7.6	4582	81.5	356	6.3	321	5.7	218	3.9	123	2.2	21	0.4	2	.04	.....	.....
1867 ..	3891	73.6	455	8.6	4346	82.3	333	6.3	283	5.4	206	3.9	94	1.8	21	0.4	1	.02	.....	.....
1868 ..	4704	76.1	454	7.3	5158	83.5	386	6.3	299	4.8	203	3.3	112	1.8	19	0.3	1	.02	.....	.....
1869 ..	4943	76.1	482	7.4	5425	83.5	367	5.7	362	5.6	209	3.2	110	1.7	19	0.3	5	0.1	.....	.....
1870 ..	5472	75.3	500	6.9	5972	82.2	443	6.1	385	5.3	278	3.8	154	2.1	26	0.4	4	0.1	.....	.....
1871 ..	5428	76.0	493	6.9	5921	82.9	436	6.1	330	4.6	288	4.0	130	1.8	31	0.4	5	0.1	.....	.....
1872 ..	6817	77.0	614	6.9	7431	83.9	473	5.3	422	4.8	310	3.5	181	2.0	28	0.3	7	0.1	.....	.....
1873 ..	5553	73.2	548	7.2	6101	80.4	470	6.2	426	5.6	371	4.9	164	2.2	48	0.6	9	0.1	.....	.....
1874 ..	5477	74.2	472	6.4	5949	80.6	447	6.1	438	5.9	359	4.9	153	2.1	28	0.4	5	0.1	.....	.....
1875 ..	5349	73.7	464	6.4	5813	80.1	551	7.6	558	7.7	348	4.8	144	2.0	39	0.5	4	0.1	.....	.....
1876 ..	5626	75.0	482	6.4	6108	81.5	436	5.8	419	5.6	370	4.9	137	1.8	21	0.3	7	0.1	.....	.....
1877 ..	6117	77.3	436	5.5	6553	82.9	436	5.5	405	5.1	366	4.6	131	1.7	15	0.2	4	0.1	.....	.....
1878 ..	4758	70.7	455	6.8	5213	77.4	452	6.7	485	7.2	392	5.8	148	2.2	33	0.5	10	0.2	.....	.....
1879 ..	5493	72.1	489	6.4	5982	78.5	443	5.8	534	7.0	435	5.7	175	2.3	43	0.6	6	0.1	.....	.....
1880 ..	5801	72.1	529	6.6	6330	78.7	529	6.6	514	6.4	426	5.3	204	2.5	31	0.4	9	0.1	.....	.....
1881 ..	6418	72.8	507	5.8	6925	78.6	589	6.7	596	6.8	482	5.5	184	2.1	36	0.4	4	0.1	.....	.....
1882 ..	6407	71.8	561	6.3	6968	78.1	561	6.3	615	6.9	527	5.9	214	2.4	34	0.4	6	0.1	.....	.....
1883 ..	6895	74.5	574	6.1	7469	80.6	575	6.1	604	6.4	478	5.1	222	2.4	31	0.3	1	.01	.....	.....
1884 ..	5880	70.9	547	6.6	6427	77.5	505	6.1	584	7.0	517	6.2	229	2.8	27	0.3	4	0.1	.....	.....
1885 ..	5478	67.2	566	6.9	6044	74.1	626	7.7	662	8.1	527	6.5	260	3.2	28	0.3	6	0.1	.....	.....
1886 ..	5768	69.2	568	6.8	6336	76.0	551	6.6	720	8.6	482	5.8	220	2.6	27	0.3	3	.04	.....	.....
1887 ..	5564	66.5	644	7.7	6208	74.2	605	7.2	717	8.6	552	6.6	251	3.0	37	0.4	2	.02	.....	.....
1888 ..	6068	67.9	645	7.2	6713	75.1	644	7.2	768	8.6	510	5.7	262	2.9	31	0.4	8	0.1	.....	.....
1889 ..	5744	66.0	661	7.6	6405	73.6	701	8.0	826	9.5	501	5.8	234	2.7	33	0.4	3	.03	.....	.....
1890 ..	6714	65.9	784	7.7	7498	73.5	804	7.9	1085	10.6	498	4.9	264	2.6	41	0.4	8	0.1	.....	.....
1891 ..	6248	62.0	789	7.9	7037	69.9	829	8.2	928	9.2	806	8.0	402	4.0	67	0.7	4	.04	.....	.....
1892 ..	7006	66.2	748	7.1	7754	73.3	798	7.5	873	8.3	728	6.9	371	3.5	53	0.5	5	0.1	.....	.....
1893 ..	5932	62.1	816	8.5	6748	70.6	780	8.2	866	9.1	742	7.8	366	3.8	44	0.5	8	0.1	.....	.....
1894 ..	6033	63.6	735	7.8	6768	71.4	801	8.4	832	8.8	701	7.4	322	3.4	59	0.6	3	.03	.....	.....
1895 ..	6411	62.2	877	8.5	7288	70.7	849	8.2	924	9.0	798	7.8	379	3.7	57	0.6	6	0.1	.....	.....
1896 ..	6115	61.7	804	8.1	6919	69.8	881	8.9	958	9.7	791	8.0	323	3.3	42	0.4	5	0.1	.....	.....
1897 ..	5797	62.1	791	8.5	6588	70.6	814	8.7	831	8.9	737	8.0	313	3.4	41	0.4	5	0.1	.....	.....
1898 ..	6443	62.0	809	7.8	7252	69.8	917	8.8	881	8.5	834	8.0	396	3.8	57	0.6	2	.02	46	0.4
1899 ..	5921	58.3	884	8.7	6805	67.0	963	9.5	1037	10.2	895	8.8	377	3.7	68	0.7	2	.02	5	0.1
1900 ..	6366	59.5	952	8.9	7318	68.4	959	9.0	1084	10.1	860	8.0	407	3.8	70	0.7	2	.02	.....	.....
1901 ..	5959	56.9	1029	9.8	6988	66.7	984	9.4	1109	10.6	929	8.9	405	3.9	57	0.5	7	0.1	.....	.....
1902 ..	5829	56.9	982	9.6	6811	66.4	1000	9.8	1127	11.0	875	8.5	379	3.7	56	0.6	5	0.1	.....	.....
1903 ..	5624	55.5	976	9.6	6600	65.1	1020	10.1	1079	10.6	947	9.3	416	4.1	58	0.6	17	0.2	4	.04
1904 ..	5873	54.3	1090	10.1	6963	64.4	1119	10.3	1203	11.1	1034	9.6	440	4.1	52	0.5	5	0.1	2	.02
1905 ..	6020	56.3	1042	9.7	7062	66.0	1056	9.9	1176	11.0	918	8.6	418	3.9	53	0.5	9	0.1	3	.03
1906 ..	5947	55.3	1164	10.8	7111	66.1	1104	10.3	1085	10.1	967	9.0	421	3.9	54	0.5	5	0.1	6	0.1
1907 ..	6085	54.4	1130	10.1	7215	64.5	1145	10.2	1275	11.4	993	8.9	494	4.4	61	0.6	4	.04	3	.03
1908 ..	5500	52.7	1055	10.1	6555	62.8	1127	10.8	1215	11.6	994	9.5	474	4.5	65	0.6	3	.03	2	.02
1909 ..	5534	53.3	1067	10.3	6601	63.6	1108	10.7	1192	11.5	982	9.5	433	4.2	53	0.5	6	0.1	1	.01
1910 ..	5423	50.4	1094	10.2	6517	60.6	1256	11.7	1352	12.6	1067	9.9	471	4.4	81	0.8	9	0.1	.....	.....
1911 ..	5134	49.3	1067	10.3	6201	59.6	1276	12.3	1249	12.0	1087	10.5	512	4.9	73	0.7	6	0.1	.....	.....
1912 ..	5117	49.0	1106	10.6	6223	59.6	1214	11.6	1351	12.9	1073	10.3	492	4.7	82	0.8	6	0.1	1	.01
1913 ..	5038	49.6	1119	11.0	6157	60.6	1194	11.7	1221	12.0	1037	10.2	484	4.8	72	0.7	3	.03	.....	.....
1914 ..	4954	47.0	1178	11.2	6132	58.1	1331	12.6	1379	13.1	1148	10.9	493	4.7	66	0.6	2	.02	.....	.....
1915 ..	4407	44.1	1152	11.5	5559	55.6	1414	14.1	1388	13.9	1114	11.1	460	4.6	62	0.6	5	0.1	.....	.....
1916 ..	4796	44.7	1276	11.9	6072	56.6	1426	13.3	1437	13.4	1212	11.3	492	4.6	79	0.7	1	.01	.....	.....
1917 ..	5123	45.1	1301	11.5	6424	56.5	1486	13.1	1585	14.0	1264	11.1	532	4.7	66	0.6	7	0.1	.....	.....
1918 ..	9151	57.1	1562	9.7	9714	66.8	1715	10.7	1620	10.1	1353	8.4	546	3.4	79	0.5	6	.04	.....	.....
1919 ..	5393	47.2	1353	11.8	6746	59.0	1412	12.4	1449	12.7	1268	11.1	495	4.3	61	0.5	3	.03	.....	.....
1920 ..	5217	45.9	1174	10.3	6391	56.3	1448	12.8	1569	13.8	1325	11.7	539	4.8	81	0.7	3	.03	.....	.....

TABLE 139.—*Average percentage by 5- and 10-year periods, of deaths by specified age periods of total deaths from all causes from 1814 to 1920, inclusive.*

Period.	Under 1 year.		Between 1 and 2 years.		Under 2 years.		2 to 4 years.		Under 5 years.		5 to 9 years.	
	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.
1814-1815	27	....	8	....	35	....	6	....	42	....	4	....
1816-1820	29	29	9	9	39	38	5	5	44	43	4	4
1821-1825	19	....	8	....	27	....	8	....	34	....	4	....
1826-1830	24	22	8	8	32	29	9	8	41	38	4	4
1831-1835	24	....	8	....	32	....	10	....	42	....	4	....
1836-1840	26	25	10	9	36	34	11	10	47	44	5	5
1841-1845	27	....	10	....	37	....	10	....	48	....	5	....
1846-1850	25	26	12	11	37	37	11	11	48	48	5	5
1851-1855	24	....	12	....	37	....	12	....	49	....	6	....
1856-1860	26	25	14	13	39	38	12	12	51	50	6	6
1861-1865	23	....	11	....	33	....	14	....	47	....	7	....
1866-1870	26	24	12	11	37	35	11	12	48	48	5	6
1871-1875	26	....	11	....	38	....	9	....	47	....	5	....
1876-1880	28	27	11	11	40	39	7	8	46	47	6	6
1881-1885	26	....	9	....	36	....	7	....	43	....	7	....
1886-1890	29	28	8	9	37	36	5	6	42	42	4	5
1891-1895	27	....	7	....	34	....	5	....	39	....	3	....
1896-1900	25	26	5	6	31	32	5	5	36	38	3	3
1901-1905	23	....	4	....	27	....	4	....	31	....	2	....
1906-1910	21	22	4	4	26	26	3	4	29	30	2	2
1911-1915	19	....	4	....	22	....	3	....	25	....	2	....
1916-1920	16	17	4	4	19	21	3	3	22	24	2	2
*	—126				—47				—68		—43	

Period.	Under 10 years.		10 to 19 years.		Under 20 years.		20 to 29 years.		Under 30 years.		30 to 39 years.	
	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.
1814-1815	46	....	10	....	56	....	14	....	71	....	11	....
1816-1820	48	47	10	10	58	58	14	14	72	72	11	11
1821-1825	39	....	8	....	47	....	12	....	59	....	13	....
1826-1830	45	42	6	7	52	49	10	11	61	60	11	12
1831-1835	46	....	7	....	53	....	11	....	63	....	12	....
1836-1840	51	49	6	6	57	55	9	10	66	65	10	11
1841-1845	53	....	6	....	58	....	9	....	68	....	10	....
1846-1850	53	53	6	6	59	59	9	9	68	68	10	10
1851-1855	54	....	5	....	60	....	10	....	69	....	9	....
1856-1860	57	56	5	5	62	61	8	9	70	70	8	9
1861-1865	54	....	5	....	59	....	9	....	68	....	8	....
1866-1870	53	53	5	5	58	58	9	9	67	67	8	8
1871-1875	52	....	6	....	58	....	9	....	67	....	8	....
1876-1880	53	52	5	6	58	58	8	8	66	67	7	8
1881-1885	50	....	5	....	55	....	9	....	64	....	8	....
1886-1890	46	48	5	5	50	52	9	9	59	61	8	8
1891-1895	43	....	5	....	47	....	8	....	55	....	8	....
1896-1900	39	41	5	5	44	46	8	8	52	54	9	8
1901-1905	34	....	4	....	38	....	9	....	47	....	9	....
1906-1910	31	32	4	4	35	37	9	9	44	45	9	9
1911-1915	27	....	3	....	30	....	8	....	39	....	9	....
1916-1920	24	26	4	4	28	29	10	9	38	38	10	10
*	—61		—64		—27		....		—18		....	

* Percentage of changes in age distribution of deaths from all causes dependent upon percentage of changes in age distribution of population from 1850 to 1920.

Plus signs denote percentage of increase and minus signs denote percentage of decrease.

TABLE 139.—*Average percentage by 5- and 10-year periods, of deaths by specified age periods of total deaths from all causes from 1814 to 1920, inclusive.*—Continued.

Period.	Under 40 years.		40 to 49 years.		Under 50 years.		50 to 59 years.		Under 60 years.		60 to 69 years.	
	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.
1814-1815	82	....	7	....	89	....	4	....	93	....	3	....
1816-1820	83	83	6	6	89	89	4	4	93	93	2	2
1821-1825	72	....	11	....	83	....	7	....	90	....	5	....
1826-1830	72	72	10	10	82	83	7	7	89	90	5	5
1831-1835	75	....	9	....	84	....	6	....	90	....	5	....
1836-1840	77	76	7	8	84	84	5	6	90	90	5	5
1841-1845	78	....	8	....	85	....	5	....	90	....	4	....
1846-1850	78	78	7	8	86	85	5	5	90	90	4	4
1851-1855	79	....	7	....	86	....	5	....	91	....	4	....
1856-1860	78	78	7	7	85	85	5	5	90	90	5	5
1861-1865	76	....	7	....	84	....	5	....	89	....	5	....
1866-1870	75	76	8	7	83	83	6	6	89	89	5	5
1871-1875	75	....	7	....	82	....	6	....	88	....	6	....
1876-1880	73	74	6	7	80	81	6	6	86	87	6	6
1881-1885	71	....	6	....	78	....	7	....	84	....	7	....
1886-1890	67	69	7	7	74	76	7	7	82	83	9	8
1891-1895	63	....	8	....	71	....	8	....	79	....	9	....
1896-1900	61	62	8	8	69	70	9	9	78	79	9	9
1901-1905	56	....	10	....	66	....	10	....	76	....	11	....
1906-1910	53	55	10	10	64	65	11	10	74	75	11	11
1911-1915	48	....	11	....	59	....	12	....	71	....	13	....
1916-1920	48	48	11	11	59	59	12	12	71	71	13	13
*	−14		+127		−8		+55		−4		+47	

Period.	Under 70 years.		70 years and over.		70 to 79 years.		80 to 89 years.		90 to 99 years.		100 years and over.	
	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.	By 5-year periods.	By 10-year periods.
1814-1815	95	....	5	....	3	....	1	....	.27	....	.04	....
1816-1820	96	96	4	4	2	2	2	2	.44	.39	.12	.07
1821-1825	94	....	6	....	3	....	2	....	.50	....	.17	....
1826-1830	94	94	6	6	3	3	2	2	.41	.45	.16	.17
1831-1835	94	....	6	....	3	....	2	....	.36	....	.23	....
1836-1840	94	94	6	6	3	3	2	2	.34	.35	.14	.19
1841-1845	95	....	5	....	3	....	2	....	.42	....	.20	....
1846-1850	94	95	6	5	3	3	2	2	.42	.42	.13	.17
1851-1855	95	....	5	....	3	....	1	....	.37	....	.12	....
1856-1860	94	95	6	5	3	3	2	2	.36	.37	.12	.12
1861-1865	94	....	6	....	4	....	2	....	.43	....	.16	....
1866-1870	94	94	6	6	4	4	2	2	.35	.39	.04	.10
1871-1875	94	....	7	....	4	....	2	....	.46	....	.08	....
1876-1880	92	93	8	7	5	5	2	2	.38	.42	.10	.09
1881-1885	91	....	9	....	6	....	3	....	.36	....	.05	....
1886-1890	91	91	9	9	6	6	3	3	.38	.37	.05	.05
1891-1895	88	....	12	....	8	....	4	....	.56	....	.05	....
1896-1900	88	88	12	12	8	8	4	4	.55	.56	.03	.04
1901-1905	86	....	14	....	9	....	4	....	.53	....	.08	....
1906-1910	86	86	14	14	9	9	4	4	.59	.59	.05	.07
1911-1915	84	....	16	....	11	....	5	....	.69	....	.04	....
1916-1920	84	84	16	16	11	11	4	5	.61	.65	.03	.04
*	−1		+90		+37		+67					

* Percentage of changes in age distribution of deaths from all causes dependent upon percentage of changes in age distribution of population from 1850 to 1920.

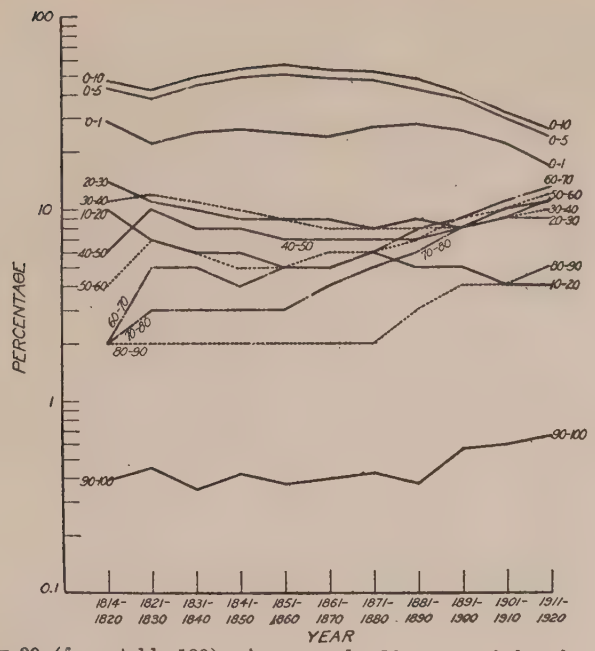
Plus signs denote percentage of increase and minus signs denote percentage of decrease.

uals in the whole population in each age-group was subject, both as regards shorter and longer periods of time (as the result of changes in the birth, immigration, and death-rates, general as well as selective for age), to variations not inconsiderable. To illustrate: for any particular age-group at one time the larger proportion of individuals or of deaths, as the case may be, may fall in its earlier portion, or at its center, and at another time may cluster near its upper boundary. Other things remaining equal, the broader the age-group, the wider the opportunities for such variations.

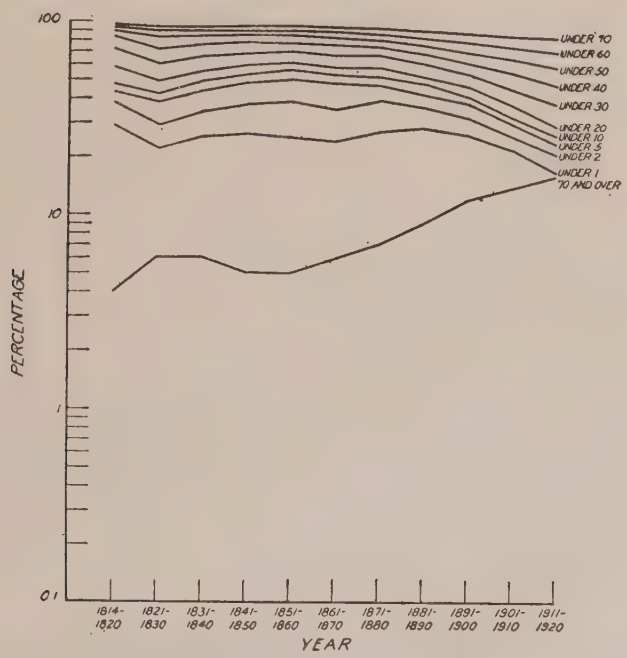
It is evident that a small percentage of deaths in one or more age-groups in one year or in a short series of years might well be due in large part, at least, to an unusually heavy depletion by death in the period immediately preceding, or conversely, that a large increase of deaths at one period in a particular age-group might be causally associated with the accumulation in it during a period of low mortality of a comparatively large number of vulnerables. However, these objections apply less weightily to the consideration of the results as measured for single age-groupings over long periods or for multiple age-groupings, as for instance, the total for all ages below the thirtieth, fortieth, or fiftieth years of life, over either long or short intervals of time. As, on the whole, changes in the proportional age distribution in respect of 10-year age groupings, though often considerable in the aggregate, took place comparatively slowly, if the ratio of deaths in large age-groupings to the total deaths at all ages follows definite trends over long periods of time, it would appear that errors inherent in this method must be largely balanced and the logical inferences drawn from the evidence will be measurably correct. If these tally in general tenor with rates specific for age that have been obtained for the census years, their value will be greatly increased. In comparing these results with similar material for other cities, it is essential to recall that these figures include deaths in a mixed population of whites and negroes, and that with the exception of certain short periods the mortality in the latter was always much higher than in the former.

From even the most cursory study of table 138 it is evident that the percentages of deaths in the various age-groupings often fluctuate within relatively wide limits, that on the whole in the earlier and mid-years of the period under consideration, the proportion of deaths in the age-groups below middle life was very high and the proportion above this period of life was relatively low. After 1875, especially, the latter group gained and the former lost in importance. In 1816, one of the most unfavorable years for the earlier years of life, the percentages of deaths in the various important age-groups were: Under 1 year 36.2, under 5 years 49.7, under 10 years 53.8, under 40 years 87.5, under 50 years 91.5. In 1822 the percentages of deaths had fallen, under 1 year to 15.8, under 5 years to 28, under 10 years to 32, under 40 years to 73, and under 50 years to 83.9. In 1875 the proportions were: Under 1 year 30.5, under 5 years 47.2, under 10 years 54.2, under 40 years 73.7, under 50 years 80.1. By 1920 the proportions were markedly changed, as follows: Under 1 year 17.5, under 5 years 23.3, under 10 years 25.1, under 40 years 45.9, under 50 years 56.3. And similarly, in other years, very great variations occurred in the proportion of deaths in all the age-groups.

Turning to the percentages averaged for 5- and 10-year periods (table 139 and graphs 39 and 40), it will be observed that the proportion of deaths



GRAPH 39 (from table 139). Averages, by 10-year periods, of percentages of deaths by specified age-periods of total deaths from all causes, from 1814 to 1920, inclusive.



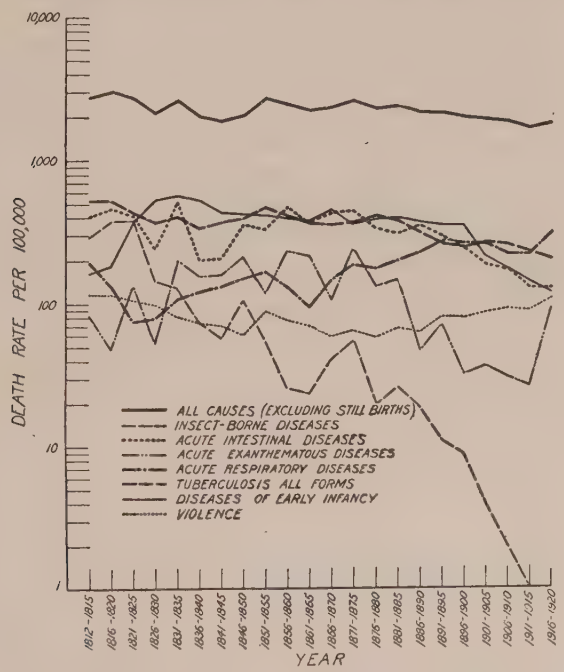
GRAPH 40 (from table 139). Averages, by 10-year periods, of the percentages of deaths under certain ages to total deaths, from 1814 to 1920, inclusive.

within the various age-groups, as well as under certain ages, followed very definite trends. On account of the greater smoothness of their curves, discussion will be confined to the rates as averaged for 10-year periods. For the age-groups under 1, 0 to 5, and 0 to 10, after a decided decline between 1820 and 1830, the percentage rose for several decades (until 1860 in the two latter groups) and thereafter declined continuously and markedly to the end. In the second decade of life, except for a slight rise in 1880, the decline in the proportion of deaths was continuous. A similar fall characterized the course for the age-group 20 to 29 years until 1900, after which the proportion rose in a moderate degree. For all the age-groups above the thirtieth year there was a considerable rise between 1820 and 1830, followed by a gradual decline to a lower level, reached usually between 1860 and 1880. This decline was invariably succeeded by an ascent which, in the higher age-groups, was very considerable. The proportionate increase for the various decades of life between 1850 and 1920, in percentages, was for the fourth, nothing; in the fifth, 37; in the sixth, 140; in the seventh, 222; in the eighth, 267; in the ninth, 100. Similarly, the percentage of decline was in the first decade, 51; in the second, 33, and in the third, nothing.

Following, now, the course of the percentages of deaths under 1, 2, 5, and 10 years and each succeeding decade of life to the sixtieth year, it is found that for each category there was a sharp decline between 1820 and 1830, followed by a gradual ascent to a peak reached in 1850 or 1860, and succeeded by a continuous and even decline to 1920. The percentages of this decline were from 1850 to 1920, under 1 year, 41; under 2 years, 45; under the fifth and tenth years, 45; under the twentieth year, 50; under the thirtieth, 47; under the fortieth, 42; under the fiftieth, 34; under the sixtieth, 24; under the seventieth, 13. In this same period there was an increase of 300 in the percentage of deaths in the age-group 70 years and over. When allowances are made for the changes in the proportional distribution of the population among the various age-groups in the census years 1850 to 1920 (see table 10) it appears that in this period the percentages of decline of these death-ratios dependent upon the age-factor alone were for under 1 year, 48; from 1 to 4 years, 41; under 5 years, 67; from 5 to 9 years, 34; and the first two decades of life, 61 and 64, respectively. Between the twentieth and fortieth years of life the death ratios did not vary and the percentages of change in these age-groups of the population were insignificant. In the fifth, sixth, seventh, and eighth decades and 80 years and over, 127, 55, 47, 37, and 67 per cent, respectively, of the increase in the death ratios were attributable to the percentages of proportional increases in the corresponding age-groups of the population. From the foregoing analysis the conclusion is warranted that, when corrected for the known changes in the age distribution of the population, the trends of these ratios accord in a general way with the courses of the rates specific for the corresponding age groups for the census years, confirm the deductions drawn from the latter, and indicate the proportion of the observed decline in the total mortality which was due to causes other than the age factor.

At this point it will be instructive to consider the influence upon the mortality-rate from all causes of those great groups of maladies whose courses may be followed from the beginning. This comparison, in rates averaged for

5-year periods, is made in graph 41. Of the seven groups, each composed of several distinct affections, five belong without question wholly to the infections. Of the remaining two, in one, violence, infection plays primarily no part, and in the other, certain diseases peculiar to infancy, the rôle of infections is a subsidiary one. In most of these groups there is at least one affection the death-rate of which might have been favorably influenced within the period under discussion by either medical treatment or by some forms of administrative activities. It will be observed that the curve for all causes of death presents five distinct waves: the first from 1812 to 1830, the second from 1831 to 1845, the third from 1846 to 1865, the fourth from 1866 to



GRAPH 41 (from tables 18, 20, 43, 61, 79, 123, 129, and 133). A comparison, in crude rates averaged for 5-year periods, of the contribution of seven important groups of diseases to the total mortality from all causes, from 1812 to 1920, inclusive.

1880, and the fifth from 1881 to 1915. In comparing the curves for each of these groups with that for all causes, there appear certain striking correspondences which in large part may explain the latter. In the first wave the rise and fall in the mortality-rates for all causes is definitely associated with similar changes in the rates for insect-borne, intestinal, and acute respiratory diseases and for tuberculosis. Violence conforms in less degree, but exanthematous diseases and certain diseases of infancy not at all. In the second wave, intestinal and exanthematous diseases, affections of early infancy and tuberculosis conform distinctly with all causes. In the third wave, while intestinal, respiratory, and exanthematous diseases follow the curve for all causes most conspicuously and exactly, all the other groups, except early infancy, display

rises and falls. The same phenomena are repeated in the fourth wave. In the gradual descent between 1881 and 1915 in the curve for all causes, insect-borne, intestinal, and exanthematous diseases showed marked recessions, while tuberculosis, acute respiratory diseases, and diseases of early infancy declined sensibly. Violence, on the other hand, rose gradually. The distinct rise since 1916 in the rate for all causes was associated very definitely with increases in the rates for acute respiratory and the exanthematous diseases (influenza) and violence.

While it may not be claimed that these groups of affections were the sole causes, it does appear that they were mainly responsible for the high mortality-rates, and that, embracing as they do all the more important factors concerned in rapidly fluctuating rates, they represent the main elements of elasticity in the total mortality-rates. Other things remaining equal, it is mainly through these groups of causes that the total death-rate may be seriously affected by either natural or artificial means, so far known. As they have regressed in importance as causes of death, the total mortality-rates have not only fallen, but tended to stabilize. As these groups have both contributed in very large proportion to the total deaths and represented the chief factors of elasticity in the death-rate from all causes, their disappearance, or even their further serious diminution in lethal force, would result in the stabilization of the total death-rate at a yet lower level.

Chapter XX.—Summary and Conclusions.

The febrile diseases; Affections peculiar to child-birth and to early infancy; Violence; The chronic organic diseases. (Tables 140 and 141.)

It now remains to summarize and to correlate the essential facts collected and analyzed in the foregoing chapters, with the design of reaching generalizations from which instructive lessons may be deduced.

The febrile diseases.—On both historical and practical grounds it is convenient to consider first the febrile diseases, concerning which certain important facts stand out with striking clearness. Without exception, the course of each particular disease studied has been marked by advances and recessions of mortality which have flowed and ebbed in series of tides of uneven volume and force. A few have advanced and receded like tidal waves; others have pursued a less uneven course. For many of them similar courses can be traced for morbidity. When measured by rates specific for age, race, and sex these characteristics persist. For certain groups of these diseases, especially those in which transmission appears to be confined largely if not entirely to direct contact through individuals, these characters, while modified in degree, have not been changed in quality by any artificial barriers that have been set up from time to time. In the case of each particular disease of this class, except pneumonia and influenza, that can be followed continuously over a long term of years, mortality-rates have fallen conspicuously since 1885 or 1890, and by the end of the period embraced in this study are at or near their lowest ebb. In the case of all of the important febrile diseases, importation from without has been an important factor. As between the two great groups of these diseases, these changes in incidence and mortality have occurred, on the whole, in different fashions for the nuisance and the contactive diseases; in the former the declines were gradual, while in the latter, as measured in terms of mortality at least, the decreases were comparatively abrupt.

Considering first the diseases whose spread is governed so largely by environmental conditions, the nuisance diseases in the broad sense, attempts at artificial interference were rewarded by a considerable measure of success after a long and poorly managed campaign. The efforts, correct in principle, directed against the mosquito-borne diseases, were more determined and persistent, and consequently were sooner affective. However, owing to the natural history of these diseases, the problems were simpler. With yellow fever the obstacles to be overcome were less difficult, for the following reasons: The high case-fatality rate and short interval between invasion and death diminished opportunity of spread; the apparent inability of the stegomyia mosquito to breed in numbers except at Fell's Point, long the sole place of docking of ships from infected ports, tended to confine the disease to this locality except under unusual conditions of wind; the complete recovery without becoming carriers of those who survived, and the effect of cold upon this species of mosquito, combined to make it practically impossible for the disease to survive the winter;

the disease was usually imported over a great distance, from places where its prevalence has greatly diminished and from which trade has decreased.

Malaria, on the other hand, was indigenous, and conditions for frequent importation from near and far were peculiarly favorable; case-fatality also was relatively lower, and many infected individuals carried the parasites over the winter season; and the malaria-carrying species of mosquitoes were abundant and widely spread in the city, over a large part of which conditions were for many years particularly favorable for their multiplication. The influence of importation of the disease upon both prevalence and severity of attack and of cinchona upon its cure and final eradication can hardly be overestimated. When the disease was at its zenith in incidence and mortality, cinchona was scarce and expensive; in the period of decline, importation had fallen off, cinchona preparations were abundant and cheap, and conditions favorable to extensive mosquito breeding were gradually reduced to a comparatively low point.

In this connection, there remains to be considered yet another factor, namely, the possible inability of the malignant types of malarial parasites to preserve their lethal force for an indefinite period in an uncongenial climate. Experience has demonstrated that the victims of severe chronic malaria acquired in tropical or subtropical countries, and which has resisted specific treatment, often improve and gradually recover after prolonged residence in cooler climates. It is conceivable that the action of the latter, whatever its character, may be exerted deleteriously upon the parasite as well as beneficially upon the host, as is commonly believed. Therefore it is not improbable that virulent types of malarial parasites imported from the West Indies, South and Central America, and the South Atlantic and Gulf States became so modified in the bodies of their local hosts during the relatively severe winters of Baltimore that, when transferred to new hosts with the reappearance of mosquitoes in successive summers, while preserving their infective qualities, they suffered a reduction in their lethal force. Such modifications may have been either rapid or gradual. Modifications in virulence may have been induced, in part at least, by the deprivation in the northern climate during several months in the year of the accustomed opportunity of the parasites constantly enjoyed in hot climates, for frequent change to new human hosts and for possible reorganizations in the bodies of new mosquito hosts necessary for the preservation of their virulence to man.

With typhus fever, frequently imported, long endemic, and often occurring in serious epidemic outbreaks, neither sanitary measures nor specific treatment come into consideration. Without serious attempt at artificial interference, it died out and afterwards, when awakened again after long slumber or when reintroduced from without, it has invariably failed to spread, although, as proven by the results of inspection of school children, a not inconsiderable proportion of the population was louse infested.

For the second group of the typically nuisance-borne diseases, the acute intestinal affections, progress was slower. So far as general sanitation is concerned this was due not so much to deficiency in knowledge, but to lack of appreciation on the part of the public of existing information concerning the importance of sanitary measures. The situation was greatly complicated

by the rapid growth of population, the great cost of overcoming the considerable physical difficulties involved, and the continued reimportation on a large scale of all of these diseases, save cholera. This factor continues to the present day to be of considerable importance in connection with typhoid fever. The mortality from the group as a whole was high at the outset, and, running in a series of waves, reached a comparatively low point by 1840. Then, after a period of heavy immigration, associated with the importation of cholera, typhoid fever and dysentery, mortality attained its acme by 1855. But for a slight setback between 1886 and 1890, its decline has been steady since 1875. As judged by mortality, their courses reflect, on the whole, at any given period during the 109 years over which it may be followed, the state of general sanitation in regard to water and milk supplies, the disposal of night-soil, the extent of fly breeding, the degree of importation of cases and of infected foods, and the efficacy of medical and nursing care. Administrative control of persons ill of these diseases has played no part in the result, except in the case of cholera in 1866 and of typhoid fever since 1916. That the improvements since 1890 in medical management and nursing in typhoid fever and cholera infantum and in the feeding and care of infants have exerted a favorable influence upon mortality from these affections can not be questioned. The continued morbidity of typhoid fever among individuals in whom extra-urban infection can be excluded and of cholera infantum, and the occasional epidemics of dysentery among infants, since the revolution in connection with the control of water, milk and night-soil, and the notable decrease in flies, all effective since 1917, suggest very strongly that transmission of their causal agents from person to person is now limited very largely to contact, either directly or indirectly, through foods infected in households.

Turning now to the contactive diseases and considering first the two groups, the exanthematous and the acute respiratory affections, in which the transmission of the causal agents is apparently restricted largely if not completely to personal contact with the sick or with carriers, it will be recalled that conditions were entirely different. While the former group as a whole exhibited a marked decline in mortality between 1875 and 1915, and had indeed by the latter date become relatively unimportant, in the quinquennium ending in 1920 the mortality for the latter exceeded the levels of 1812–1820 and 1826–1830.

The course of the diseases of the first or exanthematous group is remarkable chiefly in the following respects: Each important member, i. e., small-pox, measles, scarlatina, and influenza, after repeated epidemic visitations, finally achieved endemicity and caused considerable mortality. Two, scarlet fever and measles, without artificial interference afterwards fell to negligible grades of mortality. One, small-pox, after a long period of endemicity disappeared completely, only to reappear twice (1872–1873, 1882–1883) in severely fatal, and twice again in milder epidemics. This disease flourished and declined under a *laissez-faire* vaccination policy; subsided after vigorous vaccination campaigns; and, though frequently reintroduced, has failed to become a serious menace since the adoption, with the use of potent virus, of a vaccination policy of a moderate degree of effectiveness in regard to general vaccination of children and revaccination of adults. The records show that

while epidemic small-pox attacked some individuals who had good recent vaccination scars and a considerable number who had been vaccinated many years before, the former were invariably but slightly ill and among the latter the mortality was much lighter than among the unvaccinated. It appears also that an attack of small-pox itself by no means always conferred lasting immunity, for in severe epidemics varioloid, though rarely fatal, was by no means uncommon. The evidence at hand indicates that the decline in the incidence and the mortality from small-pox was closely correlated with the wider adoption of vaccination with improved virus.

Though both measles and scarlet fever have declined conspicuously in mortality since 1880, they have increased greatly in invasive capacity or attack-rate. In this respect they are in singular contrast to typhus fever, which disappeared spontaneously and has repeatedly failed to spread after reimportation. Chicken-pox has shown no decline in morbidity during the 20 years for which records exist. Influenza, after repeated epidemic waves, finally became endemic, with a fluctuating but always appreciable mortality-rate since 1890. Since the pandemic of 1918, endemic influenza has risen above the previous levels in both incidence and lethal force. Members of this group of diseases have been imported frequently not only as epidemics, but many of them more or less constantly while endemic.

The group of acute respiratory diseases declined in mortality from the high level of 1812–1820 to a comparatively low point by 1826–1830, and continued to rise almost unbrokenly until 1881–1885. Thereafter their mortality-rate fell steadily until 1911–1915, but in the last quinquennium there was a decided reaction. The increase in mortality between 1831 and 1885 was shared by all three members of this group, but the decline between 1886 and 1915 was restricted to whooping-cough and diphtheria, while pneumonia remained relatively stationary. The ascent in mortality after 1915 was due almost entirely to pneumonia. All three diseases were endemically established prior to 1812, and their importation has been unrestricted from the beginning.

Since no measures of restriction have been attempted against pneumonia, and the inadequate efforts to interfere with whooping-cough date from 1916, the courses of these diseases reflect their actual natural history in this population. While diphtheria had fallen decidedly in mortality before the introduction of intubation and of antitoxin in the last decade of the nineteenth century, considerable credit must be given these two measures in connection with the very decided secondary fall, which has occurred since 1895. Notwithstanding the institution of restrictive measures in 1898 and their continuous amplification since this date, morbidity, on the other hand, has not followed the course of mortality, but has gradually increased in recent years.

Of the remaining acute communicable diseases which are or seem to be spread largely if not entirely by contact, epidemic meningitis, erysipelas, and puerperal septicemia have declined in incidence and mortality in recent years, while poliomyelitis has come into prominence for the first time. Since no administrative measures have been directed to the control of erysipelas and puerperal infection, declines in incidence and mortality from these must be attributed partly to their natural history and partly to the development and practice of antisepsis since about 1890. Restrictive measures and antiserum

treatment may have been instrumental in controlling epidemic meningitis in the slight revival of this disease in 1917. There is no evidence that efforts at artificial control exerted any influence upon the course of poliomyelitis in and since 1916.

Critical analysis of recorded data indicates that the observed changes in the death-rate from tuberculosis have not been appreciably influenced by improvements in general sanitation nor by restrictive and other measures applied to persons and their environment since 1910. A decided decline in the mortality from tetanus coincides with the development and use of antisepsis and of prophylactic treatment with antitoxin, and the control of the use of explosive crackers and caps by children.

It is notable that the diseases whose courses have been unaffected by artificial interferences, but which have at the same time shown the most conspicuous declines in mortality, are affections which are distinctly general or systemic and without specific local inflammatory reactions. In this respect compare measles, scarlet fever, and typhus with whooping-cough and pneumonia. Among the affections which have been subject to artificial interferences the same holds true, as is illustrated by comparison of malaria and yellow fever with the intestinal diseases, diphtheria, and pulmonary tuberculosis.

The record shows very clearly that, with the exception of small-pox, no attempts were made to control the spread of any of the contactive diseases by isolation of the sick and their contacts until the closing years of the nineteenth century, and that before 1910 all efforts in this direction were imperfect in execution. It has been shown that for most of these diseases such practices at best can in the nature of the case do no more than prevent association of the sick and their household contacts with the general public for the period between diagnosis and death or recovery, and can rarely cover the periods of incubation and the indeterminate carrier stage, except for diphtheria and epidemic meningitis. The extensive systems of disinfection of household and institutions with formaldehyde gas and of sterilization of garments and bedding by steam or their destruction by fire have signally failed to exercise appreciable influence upon the spread of the causal agents of a single disease. Long before these practices were put into effect the mortality of each and every one of the diseases upon which they were tried had declined conspicuously, and since these activities were instituted the morbidity of most of them has increased decidedly. Upon tuberculosis, against which, since 1910, with the exception of diphtheria, the greatest and most costly efforts have been expended, no appreciable impression has been made by these specific measures.

Hospitalization of cases of acute contactive diseases has without doubt resulted in many recoveries, especially in recent years, but on account of the relatively small scale upon which it has been practiced, if for no other reason, this procedure can not have materially influenced morbidity. In the few diseases of this class, such for instance as diphtheria, scarlet fever, tuberculosis, actinomycosis, and anthrax, whose causal agents may be transmitted by the mediation of foods as well as by contact with infected human beings, and for some of them with lower animals, the methods of restriction developed within the last 10 years against the typically food-borne diseases have doubtless narrowed this avenue of infection.

In the period under review, the scope and character of the investigation of school children in practice can have had no effect upon the control of the common contactive diseases in individuals of this age. It is pertinent to remark in this connection that even the most elaborate system of inspection of school children with the exclusion of those found ill could not by any possibility seriously control morbidity from these diseases, for this crucial reason—the chief incidence of all the important diseases of this class is in the age-group below school age. It would appear, indeed, that the supposed correlation in time between the opening of schools and the increase of the various communicable diseases of childhood either does not exist in fact or is spurious. These seasonal variations of incidence were well established before there were schools for the larger part of the child population, and for but one of the affections under discussion (diphtheria) does the attack-rate usually increase significantly in the early fall. For most of them the acme is reached in the late winter or spring. That the morbidity from these diseases may be reduced in some comparatively small degree by a constant and close inspection of children in school, followed by exclusion of recognized cases may be granted, but in the cities where it has been adopted there is no evidence that over a term of years the morbidity-rate has been seriously affected. Among other reasons, the other sources of contact in a large community are sufficiently great for the transmission of the causal agents of these affections. For the occasional protection of a few individuals the procedure is undeniably effective, but the point here insisted upon is that for the mass of individuals composing the most susceptible portion of the population it can afford no really adequate and permanent defence. The intelligent use of detention wards for candidates for admission has seemed to prevent the entrance over long periods of time of certain of these affections into closed institutions harboring young children, and this procedure is reasonable.

In regard to the introduction from without, it has been shown that until very recent years maritime quarantine afforded a very ineffectual barrier. It not only failed to hold against the particular diseases it was designed to exclude, but overlooked many more which it should have kept out. Nor have other portals been protected. With the exception of plague, every communicable disease, from yellow fever to leprosy, prevalent in the United States, has entered from time to time by Baltimore's back or side doors. Nor is it possible to prevent this, and the reverse is equally true. The important diseases dealt with in this free interchange are malarial, yellow, typhus, scarlet, and typhoid fevers, cholera, dysentery, diarrhœa, small-pox, chicken-pox, measles, influenza, diphtheria, whooping-cough, pneumonia, meningitis, poliomyelitis, tuberculosis, and the venereal diseases.

The official mortality-rates from yellow fever, typhus fever, small-pox, and tuberculosis have been materially reduced as the result of exportation of cases to hospitals situated without the city limits.

In the period under review, except for the prevention of ophthalmia neonatorum, no attempts have been made by the health authorities to control the prevalence of the so-called venereal diseases. The Baltimore population has been dominated in this respect by the traditional bonds imposed alike by the fallacies of religious custom and moral prudery, according to which cure of the

transgressor infected while breaking the illy-kept code of sexual morality is permissible or even laudable; education in methods of prevention are interdicted. In an age in which the chief shibboleths are education and personal hygiene, for the important diseases whose natural history best lends itself to the influence of protective measures personally applied, technical instruction in their use is proscribed, although it is well established that promiscuous intercourse, upon which their spread is so largely dependent, shows no signs of actual decrease.

It will be profitable to inquire into the degree in which improvement in medical treatment and care may have favorably influenced the course of mortality of the febrile diseases since the opening of the nineteenth century. It is evident that consideration must be given to changes in methods of use as well as in the number and kinds of remedial agencies available at different periods.

Strictly medical treatment, as opposed to mechanical or surgical measures fall, when reduced to simple terms, into two broad classes, the topical and the systemic. The members of the former class act chiefly as protectives, diluents, detergents, irritants, corrosives, astringents, and antiseptics, and are applied to the skin or to the mucous membranes of the conjunctival, nasal, buccal, faucial, gastro-intestinal, and genito-urinary tracts. Of these, many efficient representatives have been used from time immemorial. In the light of modern knowledge, but little *curative* value may be conceded to them in the exanthematous diseases, pneumonia, whooping-cough, or diphtheria. It is conceivable that emetics may have influenced in occasional cases the separation and expulsion of the false membranes of laryngeal diphtheria. In diarrhœa and dysentery, and perhaps in cholera, cathartics, astringents, antiseptics, and clysters have undeniably exerted a favorable influence upon mortality. Similarly, in the treatment of gonorrhœa and other infections of the genito-urinary tract, and of various pyogenic infections of similar character, some of them have been efficacious. That remedies of this class have been applied, except under the influence of modern surgery, with more skill and judgment in recent than in earlier years may well be questioned.

The systemic remedies, which, by some means, usually absorption from body surfaces, reach the vascular streams and thus become more or less widely transported through the organism, exert their influence upon certain organs and systems directly and upon the system as a whole indirectly. The medicines of this class applicable to the treatment of the febrile diseases may be divided for present purposes into several main classes: The stimulants, such as alcohol, ether, camphor, caffein (in coffee), digitalis, nux vomica; depressants, such as veratrum viride, aconite, mercury; narcotics and hypnotics, such as opium and its derivatives, chloral, the bromides, and the like; the diuretics, such as various salts of potash and soda, squills, and digitalis; diaphoretics, such as camphor, etc.; expectorants, such as various salts and vegetable extracts; tonics, such as iron, arsenic, mercury, cod-liver oil; alteratives, such as the salts of iodine and various vegetable extracts; antispasmodics, such as ether, chloroform, turpentine, assafœdita; specifics, such as cinchona for malaria, mercury for syphilis, ipecac for amœbic dysentery. These are typical representative drugs used internally in the treatment of the febrile diseases during

most of the nineteenth century. Most of them appear in the Formulæ Selectæ (67) of Drs. Samuel K. Jennings and Thomas Owings, collected between 1808 and 1825. Many other agents, some falling under other classes, were in common use. Some were noxious, some perhaps possessed healing virtue, and many others were inert. With few exceptions, the coal-tar derivatives, introduced in ever-increasing numbers since 1875 and much lauded as febrifuges, can hardly be credited with strictly curative properties in this class of disease. Salicylic acid, used first in oil of gaultheria, appears to exert a specific curative effect in acute articular rheumatism.

Stimulants in the depression of the acute stages of the febrile diseases and tonics and alteratives in convalescence doubtless often saved life, and the ease from pain conferred by narcotics and hypnotics must be credited with salutary effects. It has been pointed out already that the exhibition of cinchona on the large scale must have been an important if not the chief influence in the great reduction of morbidity and mortality from malaria. It is likely that the routine use of ipecac in the treatment of dysentery was curative in some cases of the amœbic type of this disease. That the curative powers of mercury in syphilis was, until the introduction of salvarsan, the sole artificial influence in lessening the ravages of syphilis can not be denied. The favorable action upon mortality of antisera in diphtheria, tetanus, and epidemic meningitis fell in the twentieth and not in the nineteenth century. So far as the influence of substitution diseases is concerned, hydrophobia has never been epidemic in Baltimore, and but small opportunity has been offered to apply Pasteur's preventative treatment for this malady. It has been shown that not until after 1882 was vaccination routinely practiced to the degree necessary to control small-pox.

With the exception of the beneficent use of the few specifics, it is doubtful if, on the whole, so far as drugging and blood-letting in the acute febrile diseases are concerned, physicians did not until recent years kill at least as many of the desperately ill as they benefited. The poisoning by mercury pushed to salivation in diphtheria and pneumonia in particular was certainly responsible for many deaths. There is no evidence that any drugs or other medicaments now or ever used are capable of exerting specific *curative* effects upon any of the exanthematous diseases, nor upon typhus and typhoid fevers, whooping-cough, pneumonia, bacillary dysentery, cholera, the diarrhœas and tuberculosis, nor, until the specific antisera came into use, upon diphtheria, epidemic meningitis, and tetanus. It may not be denied that in some of these diseases, more particularly in those in which the primary lesions are seated in the intestines, the use of topically applied cleansing, astringent, and antiseptic agents and of stimulants, narcotics, and hypnotics has tided over many individuals sick with these affections during the critical period while active immunity was in process of development.

To the improvement in the methods of management of those ill with febrile diseases for which no specifics existed, much more credit for reduction in case-fatality is to be given that can be ascribed to the exhibition of drugs. The substitution of careful management of those sick of the febrile diseases for the traditional drastic bleeding, drugging, and other depleting practices was a great step in advance. From small beginnings in earlier years, with

the growth of knowledge of pathological anatomy, the "expectant" or symptomatic treatment emerged into prominence by 1875. It was about this time that the medical world rediscovered and began thoughtfully to realize the truth of the ancient doctrine, *vis medicatrix naturæ*. Of great service, indirectly at least, in the reaction against the time-honored practice of depletion in acute febrile diseases was the school of homeopathy. When practiced according to its tenets it commonly amounted to drugless treatment, and thus, though not so realized by its devotees, it was well-nigh identical with that of the school of therapeutic nihilists within the regular profession who based their practice upon the solid ground of pathological anatomy and controlled experiment. In consequence of these two movements, each resulting in the withholding of depleting remedies and measures, the world had the opportunity to reobserve the important fact that in these affections there is a strong natural tendency to recovery. The revival of the ancient practice of the free use of water, within and without, in acute fevers, of more intelligent feeding, especially in acute intestinal disorders and in pneumonia and tuberculosis, the improvements in nursing and in hospital facilities, have all had a beneficial influence in reducing mortality. The methods of the leading physicians in 1880 or 1890 were generally accepted by 1910. The invention, about the middle of the nineteenth century, of the hypodermic syringe, with which remedies may be introduced rapidly into the system, has had a most important influence in saving lives and in hastening recovery in certain febrile diseases. The beneficial effects of this method of administering remedial agents were gained first in malaria, syphilis and the diarrhœal diseases (by accelerating the action of the salts of cinchona, mercury, and opium), and much later this instrument rendered possible the administration of the modern biological remedies conferring active and passive immunity, such as the bacterial and other vaccines and the various immune sera.

Advances in surgery, or that branch of the medical art that seeks to give relief by the application of mechanical measures, have to a large though not accurately measurable degree favorably influenced fatality rates in certain acute febrile diseases. Its special contributions here have been directed against secondary suppurative foci, such as otitis media, mastoiditis, empyæma, intestinal perforation, appendicitis; puerperal and gonorrhœal infections of the female organs of generation; and other suppurative affections of various other abdominal organs; chronic infections of the teeth and tonsils; and in bone, joint, lymph-gland, and serous membrane tuberculosis. To the old operation of tracheotomy and its modern substitute intubation are to be credited many lives rescued from laryngeal diphtheria. In the relief of mechanical obstructions, such as concretions of the urinary bladder, kidneys, and the biliary system, of hypertrophies of the prostate, of strangulated hernia, and other causes of intestinal obstruction, the contributions of surgery to the prolongation of life have been notable. Particularly in the past 30 years has the mortality from tumors been influenced by surgical means. In connection with injuries of various kinds, surgery has rescued many lives. While the field of surgery has been enormously widened since the introduction of anesthesia, and particularly of antisepsis, and the development of knowledge of pathological anatomy (to which it has made large contributions), a large if not the major part of its general principles are of ancient date.

In essence, the foregoing picture represents a series of struggles between the individuals of the population on the one hand and groups of parasitic micro-organisms on the other. Many individuals have been attacked repeatedly by different species at separate times, by several species at the same time, and by the same species several times. The severity of these attacks has varied greatly with different individuals and at different periods. In this complex conflict the population, though hard hit at times, has never been seriously menaced, but the invading micro-organisms have often proved unable to maintain the battle even after repeated importation.

Considering first the population, it will be recalled that it has been found that its members have differed in their natural susceptibility, as judged by both morbidity and mortality, and that of the variables it has been possible to analyze in these respects the most important and constant in their action are associated with age, race, and sex.

Rates specific for age demonstrate beyond a question of doubt that both morbidity and mortality of measles, scarlet fever, chicken-pox, mumps, whooping-cough, diphtheria, epidemic meningitis, and poliomyelitis are and have been, so far as these records go, largely if not entirely confined to the first decade of life. Indeed for most, though not for all, of these diseases, the heaviest incidence and fatality lie between the seventh month and the fifth year. The relatively high natural immunity to attack and fatality that exists against these diseases during the first 6 months of life suffers a severe loss between the seventh month and the fifth year, but is then gradually recovered, so that after the tenth or fifteenth year the balance is restored, and whatever the degree of exposure, incidence and death are relatively rare. With measles, which of this group of diseases has the highest degree of incidence, a large part of the immunity possessed by the population over the age of 10 is perhaps actively acquired as the result of attacks earlier in life. Tetanus and erysipelas belong to this group, and until vaccination was widely adopted, small-pox was doubtless in Baltimore as elsewhere peculiarly a disease of childhood. Concerning malarial, yellow, and typhus fevers, there are no recorded data for estimating the influence of age upon morbidity and mortality, but from common experience it is well established that the young are particularly susceptible to these diseases when prevalent. Diarrhœa and dysentery, while attacking all ages, have their heaviest mortality in early life—and with diarrhœa the bulk of the mortality occurs in the first year. While no data concerning the age distribution of cholera are to be found in the records, it is notable that in cholera years the mortality from cholera infantum was particularly high. Typhoid fever and influenza belong to the group of infectious diseases that attack all ages, but the mortality of the former is rather heavier before than after the fortieth year of age, and the reverse is the case with the latter.

Pneumonias, both lobar and broncho, are characterized by high incidence and mortality in early life, but for 20 or 30 years after age 10 their rates are low. After the fortieth year, however, they gain renewed strength and attain their acme in old age. Pulmonary tuberculosis, with comparatively low rates of morbidity and mortality in the first decade of life, rises sharply during the second and third decades; its mortality, after maintaining high levels from the thirtieth to the seventieth years, subsides in extreme old age. For all of

the other forms of tuberculosis taken together, the mortality is particularly high in the first year and under age 5 and, having its highest point in the first decade, runs on an even but relatively low level during the remainder of life's span.

From table 140 it will be noted that, in 1920, infectious processes were responsible for 58 per cent of the total mortality under age 40 and for only 22 per cent of the mortality above this age-period. It is significant that for pneumonia, tuberculosis, influenza, syphilis, and the pyogenic infections (puerperal fever excluded), mortality was higher after than before age 40, and that the reverse was true for dysentery, diarrhœa, typhoid fever, acute articular rheumatism, and, as is to be expected, from the infectious diseases peculiar to childhood.

The influence of race stock, as indicated by color, upon mortality from some of the communicable diseases can be measured with some exactness. According to tradition, the morbidity and mortality of the mosquito-borne diseases was much less among negroes than among whites, but Buckler recorded that in 1850 typhus fever, a disease comparatively new to this race, was more common in the negro. The records show that of the acute intestinal diseases, cholera (Buckler), typhoid fever, and diarrhœa (cholera infantum) have been consistently more fatal to the negro than to the white. In 1850, the mortality of epidemic dysentery, on the other hand, was four times greater in whites than in negroes.

For the typically contactive diseases the comparison between the negro and the white reveals interesting and significant results. The mortality from small-pox, measles and influenza (except during the epidemic of 1918) has been considerably higher in negroes. The converse is the case with scarlet fever. In 1850, the mortality from this disease was one-third greater in whites than in negroes, and during the past 15 years the rate was nearly three times greater in the white than in the negro race. It is notable that while for both measles and scarlet fever the morbidity-rates were higher in whites, the case-fatality rates were higher in negroes; in other words the negro, though less liable to attack, is more apt to die when attacked than is the white. For whooping-cough the recorded morbidity has been considerably greater among whites than among negroes, but the disease was four times more fatal for the latter. This means that in respect to this disease the negro is less susceptible to attack, but when he does contract it he is less resistant to its lethal force than the white. In 1850, the mortality from diphtheria (membranous croup) was about equal in the two races, but since 1905, at least, the mortality has been twice as great among whites as among negroes. In recent years the morbidity-rates have been consistently much higher in the white race.

For both lobar and broncho-pneumonia, since 1875 at least, the mortality-rates have been markedly higher in the negro, and the same holds true for morbidity-rates in 1921. Similarly for tuberculosis, both pulmonary and other forms, the mortality-rates for negroes have been consistently and markedly higher than for whites. There was no appreciable difference in mortality for the two races from epidemic meningitis, but both morbidity- and mortality-rates from poliomyelitis in negroes were double those obtaining in whites in the epidemic year, 1916. In 1920, the mortality from tetanus was somewhat higher and that from erysipelas was somewhat lower in negroes

TABLE 140.—*Comparison of rates of death per 100,000 living population at all ages, 0 to 39 years, and 40 years and over, from all causes and from certain groups of causes, and the ratios per cent of mortality from the same in these age-groups for 1920.*

Causes of death.	At all ages.			0 to 39 years.			40 years and over.		
	Rate.	Per cent of rate.	Per cent for the group.	Rate.	Per cent of rate.	Per cent for the group.	Rate.	Per cent of rate.	Per cent for the group.
All causes	1548	....	....	994	....	....	2940	....	....
Group I.									
Cancer	113	7.3	....	15	1.5	....	359	12	....
Cardio-vascular-renal system including embolism and thrombosis	471	30.4	....	69	7.0	....	1482	50	....
Cirrhosis of the liver	7	....	....	1	....	....	24	....	....
Other diseases of liver and biliary system	8	....	....	3	....	....	19	....	....
Diabetes	21	....	....	4	....	....	64	....	....
Diseases of the stomach (cancer excluded)	7	....	....	5	....	....	13	....	....
Hernia and intestinal obstruction	15	6.6	....	9	3.8	....	32	10	....
Genito-urinary system (Bright's disease and tumor excluded)	11	....	....	3	....	....	30	....	....
Chronic diseases of the nervous system	16	....	....	7	....	....	38	....	....
Leucæmia and anæmia	7	....	....	5	....	....	14	....	....
Exophthalmic goitre	2	....	....	1	....	....	4	....	....
Senility	8	....	....	0	....	....	58	....	....
	.....	....	44.3	.....	....	12.3	.....	....	72
Group II.									
Pneumonia (all forms)	190	12.3	....	159	16.0	....	267	9	....
Tuberculosis (all forms)	151	9.8	....	135	13.6	....	190	7	....
Whooping-cough	8	....	....	11	....	....	0	....	....
Diphtheria	14	....	....	19	....	....	0	....	....
Measles	7	....	....	9	....	....	0	....	....
Scarlet fever	2	6.6	....	3	10.7	....	0	3	....
Influenza	44	....	....	41	....	....	52	....	....
Syphilis	22	....	....	18	....	....	32	....	....
Acute articular rheumatism	5	....	....	6	....	....	5	....	....
Typhoid fever	5	....	....	5	....	....	4	....	....
Dysentery	3	7.2	....	3	14.7	....	2	1	....
Diarrhœa (including cholera infantum)	105	....	....	139	....	....	19	....	....
Appendicitis	13	....	....	15	....	....	8	....	....
Wound and all other infections due to pyogenic bacteria, puerperal fever excepted	17	2.0	....	14	3.0	....	23	1	....
	.....	....	37.9	.....	....	58	.....	....	22
Group III.									
Puerperal state	18	1	....	24	2.4	....	8	....	....
Affections peculiar to infancy including congenital malformations	117	7.5	....	162	16.3	....	0	....	....
	.....	....	8.5	.....	....	18.7	.....	....	....
Group IV.									
Violence	88	5.7	5.7	68	6.8	6.8	139	4.7	4.7
Total	.....	....	95.4	.....	....	98.8	.....	....	98.7

than in whites. During the years for which separate accounts have been kept, specific rates for puerperal fever were much higher in the negro than in the white race. Unfortunately, there are no data available for measuring the relative susceptibility to attack and death from the febrile diseases of the various branches of the white race.

Sex has exerted a marked influence upon both morbidity and mortality of the diseases under consideration, and for all of them for which suitable data are available the rates have been usually higher among males than among females. It is especially worthy of note that with the decline in the mortality from pulmonary tuberculosis which began after 1880, in both the white and the negro races the decline has been much more abrupt among females than among males.

It is clear then that these three attributes of the population, age, race, and sex, have affected profoundly the course of morbidity and mortality of the febrile diseases in the 109 years under review, and that changes in the proportional distribution of the population in these respects have influenced their courses significantly. It is a matter of great interest that the negro has proved to be less susceptible than the white to malaria, yellow fever, and dysentery, among the nuisance diseases, and to diphtheria, scarlet fever, and whooping-cough among the contactive diseases, and that during the last 70 years, in respect to the last three diseases, his resistance has increased relatively and in a decided degree. Among the other diseases for which comparison may be made over a long period, the advantage still lies with the white race in diarrhœa, typhoid fever, tuberculosis, pneumonia, and measles. In addition to these, the white has exhibited a higher degree of resistance to small-pox, typhus fever, cholera, poliomyelitis, and the pyogenic infections in general.

In connection with the influence of age upon the mortality from the various febrile diseases, it has been shown that in the declines in the crude rates exhibited by certain of these affections over a long series of years considerable allowance must be made for the known changes in the age distribution of the population, in consequence of which the ratio of individuals of susceptible age has declined or has increased. In this respect the rates from the diseases of childhood have been affected favorably and those from pneumonia and pulmonary tuberculosis unfavorably.

It will be profitable at this point to discuss briefly certain biological differences which characterize the causal agents of the febrile diseases.

The micro-organisms causing the febrile diseases considered in this work belong to three fairly well-defined groups, the obligate parasites, the facultative saprophytes, and the facultative parasites. The members of the first group, composed of true and constant parasites which are *apparently* incapable under natural conditions of prolonged existence and multiplication, except in connection with and usually actually within the bodies of living beings—man or the lower animals—are exemplified by the causal agents of malarial, yellow and typhus fevers, whooping-cough, measles, small-pox, chicken-pox, vacinnia, influenza, mumps, epidemic meningitis, poliomyelitis, tuberculosis, syphilis and gonorrhœa, and lobar pneumonia. The causes of diphtheria and of scarlet fever, under usual circumstances typical members of this group, occasionally find conditions favorable for living and even for multiplying without living bodies in milk, an animal product, and for this reason are not

obligate parasites in the strictest sense. It is more than possible that other members of this group—*B. tuberculosis,* to mention one—may also under conditions met with in nature grow in milk or other substances containing organic matter. The causal agents of malarial, yellow, and typhus fevers are peculiar in the fact that they require certain definite insects as intermediate hosts and inoculators. It is not unlikely that some among the other viruses mentioned above have similar affinities. As is well-known, hydrophobia, trypanosomiasis, and relapsing fever are caused by obligate parasites with intermediary hosts.

Typical members of the second group are the micro-organisms causing the acute intestinal diseases, cholera, dysentery, the diarrhœas and typhoid fever, all of which seem to retain their vitality in water and under favorable circumstances to be capable of multiplying, at temperatures below that of the human body, in milk and in various other substances containing organic matter. However, their normal habitat appears to be the human body, and especially lesions of its alimentary tract, and they are rarely if ever found in the outside world except under conditions indicating pollution with human excreta.

The representative micro-organisms of the third group are the pyogenic bacteria, well-nigh ubiquitous in the outside world in soil, manure, night-soil, and the like, whence they easily reach the exposed surfaces of the human body. In order that they may invade the tissues and establish the condition of infection, they commonly, but by no means invariably, require assistance in the shape of surface wounds, destructive irritants, or some previous or concomitant infection. Such organisms as the pathogenic streptococci and staphylococci, *B. tetani, B. welchii, B. mucosus,* and *B. pyocyaneus,* are to be regarded as normally saprophytes. However, when well established as faculative parasites, certain strains of staphylococci and streptococci often, and other forms more rarely, develop marked aggressiveness and a peculiar tolerance for human tissues, and are not only readily transmissible by direct and indirect contact, but cause local epidemics, of which erysipelas, puerperal fever, umbilical-cord and other types of wound infection are familiar examples. As secondary invaders, particularly in diseases caused by the organisms of the first group, they are responsible for a long series of complications, and are very effective determinants of mortality. This association is of peculiar importance in connection with the exanthemata, in which the clinical course may be greatly altered and the rate of fatality is often largely determined by mixed infection with pyogenic bacteria. Whooping-cough, diphtheria, and typhoid and typhus fevers are frequently similarly influenced. The causal agents of these affections not only provide, by injury to certain surfaces of the body, favorable points of attack for pyogenic bacteria, but, as has been proven in the case of some of them, may actually lower the general resistance to these secondary invaders.

It is evident that, in the usually accepted meaning of the terms, examples of nuisance and contactive modes of spread are offered by members of all three of these groups, but that the last two groups furnish on the whole the best examples of the former mode of dispersion. Malarial, yellow, and typhus fevers, classified from the standpoint of public-health administration as nuisance diseases, in view of the fact that they are directly inoculable to man by

means of a lower order of living things, must be regarded from the viewpoint of the causal agents as very highly developed special cases of contact infection. Indeed, they are the best known examples of their type of strictly contactively spread infections, for with them it seems certain that all other means of transmission are excluded. It is evident from practical observation that the causal agents of the intestinal diseases can spread effectively from individual to individual by direct contact alone, and in practice this method is often apparently an important if not the chief reliance of the causes of bacillary dysentery and infantile diarrhœa. The indirect method of transmission to new hosts by foods, in which they can multiply, and by flies acting as mechanical carriers, is for them a fortunate circumstance by which their opportunities for transfer in effective dosage are greatly increased. It is clear from what has been said that, generally speaking, the pyogenic infections are to be regarded as primarily nuisance-borne, and that their causal agents are ubiquitous in man's environment. Often their action is more marked in symbiosis, in which they have complicated the fight by killing their host.

It is to be recalled that healthy individuals, as well as convalescents and the totally recovered, have been proved to harbor on the body-surfaces and to be capable of disseminating certain members of each of these groups. Familiar examples are *B. diphtheriæ, meningococcus, pneumococcus, B. typhosus, B. choleræ,* streptococcus, staphylococcus, *B. tetani, B. mucosus,* and *B. welchii.* Numerous observations seem to warrant the inference that similar conditions obtain with regard to the unidentified causal agents of the exanthematous diseases. Among the acute diseases caused by obligate parasites and by facultative saprophytes, the carrier state, in or on the bodies of both individuals who have recovered and of those who have not themselves been successfully attacked, is, in the light of present knowledge, to be regarded as the last resort for survival of their causal agents, and whence new hosts may be invaded when conditions become favorable. Thus only can revival of incidence after seasonal subsidence be adequately explained. For those of these agents upon which experiment can be tried, prolonged exposure, either to direct sunlight or to drying, or to low temperatures, has proved fatal. The facts at hand seem to indicate that the possibilities of indefinite preservation of these species of causal agents in the outside world are minimal.

For the obligate parasites certainly, and for the facultative saprophytes probably, invasion of new hosts must be regarded as necessary for a complete or rounded life and therefore actual parasiticism may be said to be a necessity for the members of the first two groups and a luxury for the third group. In this sense true parasiticism implies as a normal condition of existence multiplication within or at the expense of the tissues of a living host rather than on a body-surface at the expense of excrementitious matter.

Analysis of the Baltimore material emphasizes the paramount influence of season upon the incidence of diseases caused by the parasitic micro-organisms, and the evidence at hand indicates that these seasonal variations of incidence, and consequently of mortality, on the whole, are concerned more intimately with the natural history of the parasites than with changes in the relative resistance of their hosts. The spread of the parasites of malaria and yellow fever was naturally restricted to the mosquito season, i. e., to the warm months

of the year. Typhus fever occurred at all seasons, but its greatest prevalence was in winter and spring. The intestinal diseases, spread chiefly by foods, especially water and milk, were most prevalent in the warm months, partly, at least, because conditions of temperature are then most favorable for the survival and multiplication of their causal agents in these media when infected, and when carrier flies are active.

The exanthematous diseases and pneumonia sank almost invariably to low levels in warm weather, gradually increased in activity in the fall, and attained their highest incidence in the winter and spring. Diphtheria, also of low incidence in summer, increased rapidly in prevalence in the early fall, soon reached a high level as the weather cooled, and, usually attaining its acme in December and January, gradually subsided during spring. The course of pneumonia was much the same, except that the fall rise was less abrupt and the peak was attained rather later in the winter. The monthly annual morbidity and mortality of pulmonary tuberculosis followed the seasons in a similar manner. With whooping-cough, while the recorded incidence was about equally divided between warm and cold months, mortality was decidedly higher during the former. The incidence and mortality of epidemic meningitis was confined to the late winter, the spring, and the early summer. While sporadic cases, usually fatal, of poliomyelitis occurred in winter and spring, the chief outbreaks of this disease have been confined to late summer and early fall.

These facts suggest very strongly that the causal agents of such of these diseases as are transmitted from person to person chiefly by direct contact, such as the exanthemata, whooping-cough, diphtheria, pneumonia, and tuberculosis, pass through alternating phases of invasive or aggressive capacity which are in some intimate manner determined by meteorological phenomena, and that of these temperature is the predominant factor. In this connection it is not necessary to assume the existence on the part of these organisms of complicated life-cycles such as characterize certain protozoa. Cool or cold weather or some accompanying physical state or states may act simply as stimulants to drive them to the cover of the tissues of appropriate hosts. As has already been pointed out, adequate explanation of the influence of temperature in general upon the prevalence of the nuisance diseases is found in its determining influence upon environmental conditions which favor the multiplication or the special modes of spread of their causal agents. However, for the intestinal diseases, except cholera, whose cause can not survive cold, warm weather must be regarded as only an adjuvant and not a necessity, for large outbreaks, in the case of sudden and massive pollution of drinking-water, may occur in cold weather.

The contrary behavior of epidemic meningitis and of poliomyelitis, as compared with the exanthematous and the respiratory diseases, makes necessary the assumption that the aggressiveness of their causal agents is stimulated by factors associated with hot rather than with cold weather, or that their multiplication and their spread to individuals is determined by some other environmental factors, including perhaps intermediate hosts. It is significant that for the typical contactive diseases it is not the degree of cold or of heat, but the change from warm to less warm atmosphere with which rise in invasion rate is associated, and the suspicion remains that after all the result is bound

up with season rather than with temperature changes that accompany the seasons. This material furnishes no data concerning the seasonal and other external relationships which may influence the invasive capacity of the widely different organisms causing the three great contactive venereal diseases, gonorrhœa, syphilis, and chancroid. In regard to the facultative parasites, it is significant that the pyogenic cocci when well established as parasites are apparently more active in cold than in warm weather. Familiar examples of this phenomenon are tonsillitis, broncho-pneumonia, and erysipelas.

In their struggle for existence and the preservation of their position in the cosmic order, it is evident that among other requirements for the strictly parasitic micro-organisms causing the diseases under discussion, two are of paramount importance; resistance to the protective powers of their hosts and escape from the lesions to the free surfaces of the body, whence new hosts may be invaded. The interplay of forces involved in the first constitutes an important part of the large field of immunity, a subject which can not be considered exhaustively here. In regard to the second, it will suffice to indicate that for each of the parasites of the nuisance and of the contactive diseases here considered, this point is in the main well covered. To recall a few examples, the parasites of the insect-borne diseases have developed the elaborate system of intermediary hosts, and for nearly all of the rest ample opportunity is given for escape to body-surfaces, often by means of superficial lesions, as, for instance, by the sputum in pneumonia and pulmonary tuberculosis, the skin or the mucosæ for the exanthematous diseases, the intestinal ulcers of typhoid fever, the skin in erysipelas. With others, of which whooping-cough, diphtheria, cholera, dysentery, and diarrhœa are familiar examples, the essential lesions are superficial and exit to new hosts by direct or indirect means is easy. Tuberculosis, syphilis, and gonococcal and pyogenic infections often furnish examples of inclosure of the specific parasites in lesions of the internal organs from which escape is shut off, whether the host lives or dies, as in tuberculous meningitis, syphilitic myocarditis, gonococcal and streptococcal endocarditis.

In considering the natural history of the transmissible diseases, it has become customary to view them entirely from the standpoint of the host, and to overlook the important fact that it is invasive and not lethal capacity that, biologically speaking, suits the best interest of their parasites. It is self-evident that, among the diseases caused by obligatory parasites and facultative saprophytes, death of the host is inimical to the propagation of the parasite species, and that the shorter the period between invasion and the occurrence of death the less the opportunity for development, multiplication, and escape of the parasites. From the standpoint of the parasite species the death of the host is not a triumph, but a calamity. For the satisfactory development of a strain of tubercle bacilli, for instance, it is much more advantageous that the host should survive for years, with ulcerative pulmonary tuberculosis, than die in a few weeks of phthisis florida. The causal agents of scarlet fever and measles are much more safely intrenched at the present time with their high morbidity and low mortality rates than was the case either before these diseases became endemically established or in later years, when the mortality was excessively high and the morbidity relatively low. Diphtheria antitoxin, by preserving the life of those attacked and thus favoring the carrier state, has been perhaps

as great a boon to the diphtheria bacillus as to the human species. It is clear, therefore, that all methods and means, whether they entail active or passive immunity or medical care, or even curative treatment with specifics, which delay death or which establish recovery, if not attended by destruction or encapsulation of the parasites in infected hosts, favor the propagation of the invading organisms at the expense of possible new hosts.

It has been pointed out in previous chapters that after long endemic establishment certain of the acute parasitic diseases which have become characterized for years by low morbidity and high mortality have exhibited marked gains in invasive capacity with the loss of lethal force. Clear-cut examples of this phenomenon are furnished by the courses of measles, scarlet fever, whooping-cough, and diphtheria. In this case it is evident that the result may be affected by changes in the constitutional attributes of both the population and the parasites. Since in these particular diseases both attacks and deaths are confined so largely to early youth, the period of life before procreation is possible, high case-fatality rates must tend in time to diminish in the population the proportion of individuals with feeble natural resistance to lethal issue; so that by a process of natural selection, towards the end of the period under review, those diseases whose causal agents are obligate parasites have as their material for attack a population descended from ancestors, (*a*) who resisted attack after exposure, (*b*) who were not exposed at all, or (*c*) who, though succumbing to attack, were able to escape death. From the standpoint of the parasites, natural selection must tend in the long run to favor the persistence of strains of low as opposed to those of high virulence, for the latter by killing their hosts limit their own opportunities to spread, and strains of lower lethal force must have much greater chances for propagation and transmission to successions of new hosts.

Diphtheria will serve as an example to illustrate these points. The record shows that the mortality of this disease, from at least as early as 1812 to about 1860, ran at a fairly constant and relatively low level. It is attested by an accurate observer (56) that as membranous croup, the type prevalent during this period and characterized by a very high case-fatality rate (90 per cent), it did not spread readily from the sick to the well in households and neighborhoods. In other words, while the case-fatality rate was nearly 100 per cent, both the morbidity and the mortality-rates among those of susceptible age were comparatively low. Suddenly, in association with a pandemic, when new strains of the causal agent were imported, both morbidity and mortality-rates from the previously prevalent laryngeal and the new naso-pharyngeal types rose enormously and remained at high levels for over 25 years. Thus, coincidentally with the presence in the population of a large proportion of children sprung in part from parents who had resisted the disease, mortality declined by 1890 to near its previous level. With the introduction of intubation and of antitoxin for both cure and prevention, the adoption of compulsory isolation controlled elaborately by the culture test, morbidity has actually increased in the face of a remarkable decline in mortality and in case-fatality rates. Without these means and methods of artificial interference, similar but even more marked changes occurred in these rates for measles, scarlet fever, and whooping-cough. These characteristics are in striking contrast to the behavior

of certain other diseases, such as pneumonia, typhoid fever, and pulmonary tuberculosis, which are not confined to the lower age-groups of the population and in which the duration of the illness is on the whole rather longer and the case-fatality rate is on the whole lower than in the group of affections just discussed.

However, such explanations of the observed phenomena can not be considered entirely satisfactory. It is not improbable that, in consequence of consecutive passage through generations of individuals upon whom increased resistance has been conferred by the above-discussed form of natural selection, the causal agents of many of these diseases have undergone actual as well as relative decrease in lethal force. A third alternative is the assumption that among the progeny of single organisms or of groups of organisms there should occur as a normal condition several or even many strains differing among themselves in respect of invasive and lethal capacities. In this case the increase or decrease in either one or both of these attributes occurring in connection with a particular disease, when endemically established, may be considered as being due to a chance or even to a cyclic predominance of these respective characters to an unusual degree. Similarly, the subsidence almost invariably observed in respect of one or both of these qualities within a comparatively short time, even when no restrictive interferences are interpolated, may be associated with the return in the mass of the prevalent strains to their previous state.

Lastly, it is possible that increases and decreases in invasive and in lethal force on the part of the obligate parasites may be due at some times to definite mutations in the sense of DeVries and at other times to the becoming dominant of characters long latent. Some such hypothesis is almost necessary for the explanation of such sudden and great changes in these respects as occur in the life-history of parasites at the time of great pandemics. Nor otherwise does it seem possible to explain the repeated declines and complete disappearance from the city of scarlet fever, measles, influenza, and typhus fever, after epidemic outbreaks and in the absence of any measures of control, and of small-pox under the same conditions, except imperfect vaccination. In the solution of these many and complex phenomena more than one formula seems necessary.

One set of parasites by determining the death of hosts is often inimical to another. While the parasites of most of the typical specific diseases do not as a general rule invade the same host at the same time, their hosts are often attacked by facultative parasites, particularly the streptococci and staphylococci, and frequently with fatal results. Familiar examples are furnished by the exanthemata, diphtheria, whooping-cough, typhoid fever, and pulmonary tuberculosis. The coincidence of epidemics of a disease caused by an obligate parasite with one caused by a facultative parasite may be associated with the augmentation of the lethal force of both. Illustrative instances are furnished in the simultaneous occurrence of epidemics of scarlet fever and of erysipelas, and of influenza and of streptococcus pneumonia. Similarly, the occurrence of an epidemic of a disease caused by an obligatory parasite may increase the case-fatality rate of another disease of the same class or of one due to a facultative saprophyte. Striking examples of this interaction are afforded by the

influence of the influenza of 1918 upon the case-fatality rates of whooping-cough and of typhoid fever in Baltimore. The simultaneous occurrence in the same individual of two or more diseases caused by obligate parasites is, however, not unknown; the subjects of the venereal diseases and of tuberculosis are apparently at least as vulnerable to other infections of this class as are the healthy, and syphilis, gonorrhœa, and chancroid often coexist in the same person. While the curious quality possessed by vaccinia and variola of almost completely immunizing against each other is without parallel among diseases, it is quite possible that antagonisms similar in kind though less marked in degree may exist between other febrile diseases. In this connection it is of interest to recall that the declines in the mortality from pulmonary tuberculosis following influenza epidemics in Baltimore and especially the fall in its recorded morbidity-rate since 1918 suggest very strongly that, contrary to generally accepted medical opinion, non-fatal attacks of influenza may actually protect, to some degree at least, against either incidence or fatality, or both, on the part of tuberculosis. The significant and sustained recessions in morbidity and mortality from pulmonary tuberculosis since the influenza epidemic of 1918 may well be causally associated with the circumstance that in this epidemic the incidence of the disease was unusually heavy in young adulthood and in mid-age, the very age-groups in which the sharpest declines in mortality are known to have occurred (graph 25). To limit the observed relation between this influenza epidemic and the subsequent decline in the incidence and mortality of tuberculosis to a supposed weeding-out effect of the former upon tuberculosis susceptibles in the population is unwarranted by actual conditions; these declines have been too great and too lasting to be accounted for by this factor alone and since 1918, with continuous sharp recessions in the rates of tuberculosis morbidity and mortality, endemic influenza has remained on a high level of incidence with a comparatively low case fatality rate.

Paradoxical as it may seem and abhorrent to current opinion as it is, from the standpoint of the parasite the ideal condition of existence is characterized by ready infections of new hosts with minimal mortality among the victims. And, evidently from the standpoint of the host population, with those diseases against whose parasites science and art have no methods either of extermination or of control, with which, in short, the symbiosis defies artificial control, this is the most satisfactory arrangement. After a long interplay of their respective forces, this condition has been attained between the Baltimore population and such diseases as measles, scarlet fever, chicken-pox, and mumps. Whooping-cough and tuberculosis show indications of the same course. Diphtheria has been influenced in the same direction by natural forces assisted by antitoxin. It is conceivable that, other things remaining equal, by natural methods in the course of time one or more of these diseases may gradually lose its identity and disappear. On the other hand, any one of them may, in the future as in the past, suddenly change its attributes in respect of invasiveness and lethality.

For man, preventative inoculation of natural or of attenuated living or of killed viruses or of their products has been widely used for both prevention and cure. For the latter purpose (with a few exceptions, in connection with some of the facultative parasites, such as staphylococci), the practice has been

barren of results, and therefore exerts no influence upon spread of these diseases. Inoculation for prevention, while successful in some instances, has, all things considered, proved to be by no means a perfect means of interference with the propagation of parasites by transmission from old to new hosts. Inoculation with natural small-pox virus, by producing a milder type of the disease, was eminently successful in reducing the mortality-rate, but as morbidity was raised to the maximum, from the standpoint of the causal agent conditions were well-nigh ideal. The highest degree of perfection in restraint of spread of a disease by inoculation of a living virus is attained by Pasteur's method of inoculating against rabies. The secret here lies in the production after the inoculation of an attenuated living virus of an active immunity during the normal incubation period of rabies, i. e., between infection and the efflorescence of the disease. Vaccination against small-pox is a case of substitution of one disease, a mild one, for another disease, which is ordinarily severe. Here the development of small-pox is not always permanently prevented in an individual by a single successful attack of vaccinia any more than is the case with small-pox itself, whether naturally or artificially acquired. However, by judicious repetition of vaccination perfect protection commonly is attained.

On a much lower plane of value in this connection ranks inoculation with the causal agents of certain bacterial diseases or their poisonous products, the former attenuated or even killed and the latter reduced in power by physical or chemical means. The best known examples which have proven successful in man are tuberculosis, plague, cholera, typhoid and para-typhoid fevers, dysentery, staphylococcus infection, and diphtheria. In tuberculosis, the first of these in chronological order, the method has at least a very restricted field of usefulness. In diphtheria, the last of these diseases for which preventive inoculation with the poisonous products of its causal agent (toxin with antitoxin) has been tried, the results are promising. For the rest, while these measures are often of service for short periods of time in emergencies, and especially among readily controlled groups of individuals, as in armies, on ships, and in institutions, they commonly fail in the long run to displace permanently the parasites in ordinary populations; the protective immunity is usually transient and of such a nature that growth of certain of these parasites on the body-surfaces is not seriously interfered with.

It has been made clear that curative sera, both antitoxic and antimicrobic, in so far as they may delay or completely inhibit a fatal issue without wholly destroying the parasites (and none accomplish this to a greater degree than occurs under natural conditions), must, other conditions remaining equal, favor rather than restrict the spread of the respective diseases from old to new hosts. Finally, in regard to the whole list of the "febrile" diseases, it follows as a logical necessity that any other modes of curative treatment and all modes of natural recovery which are not associated with the complete sterilization of the causal agents in or on the body, or which do not result in their permanent encapsulation in the infected tissues, must favor the propagation of the parasites and their extension to new hosts. It follows further that, except where man has been able to invent methods that accomplish these ends or that break down all means of communication through which infection is

brought about, there is no reasonable hope that diseases of this class may be curbed, much less eradicated.

In Baltimore, in one way or another and in halting fashion, after a struggle lasting 123 years, man has been able to stamp out some of the nuisance diseases (malaria and yellow fever), to materially interfere with the prevalence and mortality of others (the acute intestinal affections), and one (typhus fever) has well-nigh dropped out without his interference. Of the affections seemingly spread chiefly by personal contact, one (small-pox) is held in check temporarily by substitution, the mortality of one (diphtheria) has been decidedly reduced by medical treatment (intubation and antitoxin), one (syphilis) has probably been lowered in both morbidity and mortality by specific medication, and several (the pyogenic infections) have been curbed in both incidence and mortality to a considerable though not measurable degree by antisepsis. The incidence and mortality of one member (tetanus) of this latter group have been modified by administrative acts and specific antitoxin. It will be observed that for this group of contactive diseases practically all of the changes in incidence and in mortality were brought about by measures that are typically medical and applied for the most part at least by private physicians in the routine care of their patients. Even vaccination, though for many years required by law, is and has been, except in a few notable instances, carried out mainly by private physicians. For the rest of the important diseases of this class, including pulmonary tuberculosis, pneumonia, measles, scarlet fever, influenza, whooping-cough, epidemic meningitis, and poliomyelitis, the struggle continues to be one in natural selection between the causal agents and the host population, and barely, if at all, modified by certain medical or administrative interferences.

Such gains over the nuisance diseases as have been attained through administrative measures were either complete or well on their way under the influence of theories long exploded. The sequel has proved that the early Baltimoreans were wise in confining their attention to the nuisance diseases and to small-pox, but unwise in not dealing more expeditiously and thoroughly than they did with the conditions which favor their spread.

AFFECTIONS PECULIAR TO CHILD-BIRTH AND TO EARLY INFANCY.

The evidence at hand indicates that the maternal death-rate from causes connected with child-birth has always been high in Baltimore. The course of the crude rates for this group of causes suggests that the wide fluctuations in the rates which occurred at certain periods of the nineteenth century were due in the main, at least, to exacerbations and recessions in the death-rate from puerperal fever. It would appear that until after 1900 the rate from all other causes in the puerperal state ran a fairly constant course on a very high level. Since 1900 the mortality from puerperal fever has declined considerably, and there has been some fall in the rates from other causes. During the 6-year period 1915–1920, the maternal child-bed death-rate has averaged about 65 per 10,000 births, and something like 30 per cent of this was due to puerperal fever. The risk rate of death from causes connected with child-birth were nearly twice as great in the negress as in the white woman, and from puerperal fever the mortality in the former is more than double. In

spite of the fact that for 25 years a large proportion of the deliveries have occurred under the auspices of well-conducted obstetrical clinics, the maternal death-rate from causes connected with child-birth continues to be notoriously high. It appears that this state of affairs is only in part due to the obstetrical activities of untrained midwives.

The group of affections responsible for such high mortality in early infancy demands consideration here. Owing to lack of specific knowledge, these affections can not be delimited with sharpness into the organic or constitutional and the infectious, and the determination in respect of the primary cause of death as between these two categories of causes is even more difficult than in old age. Pathological anatomists as well as clinicians are impressed with the difficulty in determining the actual cause of death in a large proportion of infants coming to autopsy. Even with those gross malformations evidently incompatible with independent life, it is not ascertained what, if any, causal rôle is played by infection. To what degree deaths of seemingly well constructed and developed infants are due to underdevelopment, or hypoplasia, of important organs of assimilation, metabolism and regulation, and in what manner such hypothetical deficiencies are caused by inter-uterine infection, are questions which are shrouded in mystery. That congenital infections, especially syphilis, are common antecedents and concomitants of still-birth and of death within a few days after birth of apparently well-developed infants is well established. Williams attributed to congenital syphilis one-fourth of the deaths among a large series of such cases in his service at the Johns Hopkins Hospital.

The high percentage of still-births to total births (6 among whites and 13 among negroes), in 1919 and 1920, indicates that the causes of fetal mortality, whether concerned with infections, with constitutional defects, or with poor obstetrical care, continue to act with unusual force. That post-natal infections are responsible in part for the high mortality among the newly-born is attested by the high death-rate from tetanus neonatorum that obtained only recently in Baltimore. It is not unlikely that many deaths of young infants are still due to general infections with pyogenic bacteria following improper care of the umbilical cord.

It has been shown that, as measured by crude rates and by rates based upon the enumerated populations under 1 year of age for the census years, the mortality from affections of early infancy (Chapter XVIII) was not only extraordinarily high, but ran on a fairly constant level from 1830 to 1900, and after the latter date underwent a sharp decline. The rates specific for age fell from 11,029 in 1900 to 5,871 in 1920. Rates calculated upon the number of reported live-births declined from 5,207 in 1915 to 4,578 in 1920. In the latter year the mortality from this group of affections comprised 43 per cent of the total mortality in the first year, and 84 per cent of this fell within the first month of life. The mortality rates per 100,000 for the respective rubrics of this group of causes, in white and in negro infants in 1920, calculated on the basis of the reported births, are given in table 141.

The rates for negroes was conspicuously higher in each rubric, but in only one—congenital debility—was the rate significantly greater in proportion to the whole. Congenital malformations were responsible for a higher propor-

tion of the total mortality in whites than in negroes. For the two remaining rubrics the proportional distribution of mortality was the same in two races. It is significant that from not only causes acting *in utero* and at birth (still-births), but from those operative most conspicuously during the first month of extra-uterine life, the negro is a much poorer risk than the white. That this is due largely to causes inherent in race stock is supported by the fact that in a very much larger proportion of instances than the white the negro infant has the advantage of care before, during, and immediately after birth, by the two university obstetric clinics.

While congenital syphilis, gonorrhœa, tetanus, and erysipelas were credited with rates of 138, 11, 21, and 43, respectively, or about 15 per cent of the total mortality during the first year of life, only 40 per cent of the mortality from these four diseases was recorded as falling within the first month of life,

TABLE 141.

	White.		Negro.	
	Rate.	P. c. of mortality.	Rate.	P. c. of mortality.
Congenital malformations	929	22	1156	19
Congenital debility, etc	2473	58	4066	63
Other diseases peculiar to infants	765	18	1185	18
Convulsions of infants	63	1.5	105	1.6
Total	4237	99.5	6518	99.6

where the bulk of their influence would be expected to be felt. The inference is clear that many deaths from congenital syphilis and from pyogenic infections occurring at and immediately after birth must be hidden under the rubrics for congenital debility and "other diseases peculiar to infants." In the first month of life the proportional distribution of the mortality from the other groups of diseases responsible for deaths in the first year as expressed in percentages of the whole, were: for diarrhœa 6, acute diseases of the respiratory system 8, and measles 8. Scarlet fever, influenza, and meningitis caused no deaths in this age-period.

The evidence at hand indicates that the gradual but very considerable decline in the rate of mortality from affections of early infancy which has occurred since the opening of the twentieth century has been associated with a number of factors. Among the most important of these are the proportional increase in the community of mothers of race stocks among whom breast-feeding of infants is customary, the expansion of the activities of obstetric and pediatric clinics, and the development of welfare clinics for the supervision of the care and feeding of infants.

VIOLENCE.

Both of the two classes of violence, the intentional (suicide and homicides) and the unintentional (accidental) have been conspicuous causes of death in Baltimore for over 100 years. While the rates for all forms of violence have fluctuated within considerable limits during this time, on the whole there was

a decrease of 5.5 per cent. The mortality from intentional violence increased by 100 per cent between 1812 and 1920, and that from accidental causes decreased by 20 per cent. Drowning, the major cause of accidental death in the early history of the city, declined in importance in this respect by 1850. Since 1880, largely on account of the increase in steam and electric railroads and in more recent years of automobiles, the mortality from this cause of death has risen steadily. Industrial accidents are, in ordinary times, relatively unimportant causes of death in Baltimore. As deaths from falls incident to the infirmities of old age are classified under accidents, the survival during the past 50 years of a steadily increasing proportion of the population to old age has unfavorably influenced the rate for unintentional violence.

THE CHRONIC ORGANIC DISEASES.

In connection with the chronic organic or degenerative diseases, several facts of far-reaching importance stand out very clearly. The most striking of these facts disclosed by the various tables analyzed in previous chapters may be summarized as follows: The mortality ascribed to affections of this category is not only confined very largely to age-period 40 years and over, but, as a rule, increases progressively and markedly in this age-group from decade to decade into old age. The cardio-vascular-renal system is of all others the one most frequently the seat of chronic non-cancerous degenerative diseases causing death, and in this respect surpasses all the other organs of the body taken together. This is the only organ-system (or organ, the pancreas as judged by diabetes, excepted) for which mortality-rates from affections of this character, when corrected for age, have advanced conspicuously during the last 40 or 50 years. Cancer of the cardio-vascular-renal system is relatively rare. During the last 20 or 30 years the mortality from cancer of the breast and the uterus (and ovaries) has declined in association with improvement in early diagnosis and in surgical measures, and when allowances are made for improvement in diagnosis and in statistical classification, for deaths in non-residents, and for changes in the age, sex, and race distributions of the population, it is doubtful if the mortality from cancer has increased significantly.

Since age exerts the controlling influence upon the lethal force of cancer and of the various non-cancerous chronic organic diseases, light will be shed upon the present discussion by a comparison of the relative values of different causes of death in age-periods 0 to 39 years and 40 years and over for the census year 1920. In table 140 the rates of mortality, for all ages and specific for those two age-periods, from all the main causes of death are arranged in four fairly well defined groups: (1) cancer of all organs and the non-cancerous chronic degenerative affections of various organs and organ systems; (2) the definitely known infectious diseases; (3) affections of the puerperal and early infantile states; (4) violence. A few comparatively unimportant rubrics, such as asthma, chronic bronchitis, certain non-cancerous diseases of bones and joints, alcoholism, and certain general diseases, have been omitted. It will be noted that under the two age-groups compared nearly 99 per cent of the total mortality is accounted for. While this classification is in the nature of the case by no means accurate, with certain reservations

it will be found to conform closely enough to actual conditions to warrant use for the present purpose. The main difficulty concerns the confusion that naturally arises in seeking to determine the direct influence of infectious processes upon the causation of the affections of group 1, and the reciprocal influence the diseases of groups 1 and 2 upon the incidence and mortality of each other. It is obvious that it is not possible to separate each and every one of the primary and secondary infectious processes from groups 1, 3, and 4, nor to make exact allowances for the part contributed to the mortality of the affections under these groups by those belonging to group 1. However, these difficulties may be overcome to a considerable degree.

First considering group 1, there is no convincing evidence that infection is concerned in the causation of cancer and other tumors, chronic diseases of the stomach, hernia and intestinal obstruction, prostatic hypertrophy, leucæmia and essential anæmia, exophthalmic goiter, and senility. Nor are infections concerned primarily in the causation of the vast majority of cases of cardio-vascular-renal disease, cirrhosis of the liver and diabetes, and chronic diseases of the nervous system. It is true that in some instances among the last-named affections, syphilis is known to play a causal rôle. But according to the custom of the statistical division, in the case of deaths from diseases of this class, such as aneurism, arteriosclerosis, chronic myocarditis, cirrhosis of the liver, diabetes, locomotor ataxia, and general paralysis, inquiry was made of the attending physician, and in those instances in which syphilis was acknowledged to be present such deaths were classified under the rubric for syphilis, and thus the error from this source was largely though not completely offset. It is the exception and not the rule for clinicians (personal communication of Dr. Llewellys F. Barker) or for pathological anatomists to be able to identify syphilis as the cause of chronic cardio-vascular-renal disease, the most prominent member of the group. In the light of recent knowledge, it seems likely that in most cases in individuals over age 40 diabetes is the result of vascular lesions—a type of arterio-capillary disease of certain areas in the pancreas. Acute endo and pericarditis and rubrics 82, 83, 84, and 85, of which the most important is 82 (thrombosis and embolism), all supposedly primary, were responsible for rates of 11 and 30, respectively, for age-group 40 years and over. These are easily balanced by the rubric senility, deaths classified under which are due largely to breakdown of the cardio-vascular-renal system. Doubtless many, if not most, of the deaths ascribed to acute and chronic disease of the gall apparatus, with or without calculi, are due primarily to lesions associated with infections, and this would account for most of the mortality credited to "other diseases of the liver" and of the biliary system. Also, some allowances must be made for deaths from acute Bright's disease and for suppurative nephritis, renal and vescular calculi. The deductions necessary for these categories are relatively insignificant.

The question of pyogenic infections occurring in the victims of violence and of chronic organic diseases is of importance. The susceptibility of individuals in these conditions to pyogenic infections is well known. In some instances, as in the case of gunshot wounds and crushing injuries, the relation is evident, but with the chronic visceral lesions, unless the individual is bedridden, it is often difficult to decide whether a complicating acute infection such as lobar-pneumonia is determined by the primary disease.

When the lethal stage of a chronic visceral disease is of such character as to cause obstruction to a natural outlet, as with prostatic hypertrophy, or is associated with ulceration, as with some tumors, the local suppurative and general infections with pyogenic micro-organisms so common in these states are very evidently secondary, and no confusion arises in regard to either causation of the primary lesion or to statistical classification. Similarly, the proneness of individuals in the terminal stages of all of the chronic visceral diseases, and especially of cardio-vascular-renal disease, cirrhosis of the liver, diabetes, chronic disease of the central nervous system, leucæmia, and tumors, to develop acute pyogenic infections, including broncho-pneumonia, is well recognized, and the rules of statistical classification properly require that deaths of such individuals be assigned to these respective rubrics of the chronic organic diseases. For age-period 40 years and over, group 3 is of no importance, and group 4 (violence) is a slightly less effective cause of death than before age 40. Some deaths classified as due to violence, notably from falls in the aged, are really due to changes which go with senesence.

On further analysis of table 140, it is observed that the proportional distribution of mortality among the four groups and their members varies very widely for the two great age-periods under consideration. The percentages of total mortality for these groups were: at all ages, 44, 38, 8.5, and 6; age-period 0 to 39 years, 12, 58, 19, and 7; and age-period 40 years and over, 72, 22, 0, and 5, respectively. The differences in the two age-periods between the mortality from the infectious and from the chronic degenerative diseases are very significant. After the thirty-ninth year, the pyogenic infections, pneumonia, tuberculosis, and influenza, are the only infectious diseases which contribute significantly to mortality, and of the rest syphilis is the only one whose mortality-rate is not in a comparative sense negligible.

In respect of the chronic organic diseases, for which it has been shown that infection can play no very important primary etiological rôle, the most striking fact is the outstanding prominence of the cardio-vascular-renal system as the seat of fatal lesions in individuals over the thirty-ninth year of age. Next to these stands cancer, and at the foot of the list all the remaining chronic organic diseases taken together. In order of their relative importance as contributors to the total mortality, as expressed in percentages, they stand, cardio-vascular-renal disease, 50; cancer, 12; all other chronic organic diseases, 10. In other words, the chronic non-cancerous degenerative organic diseases were responsible for something like 60 per cent of the total mortality in this age-period in 1920, and of this moiety the overwhelming proportion was due to cardio-vascular-renal disease.

Since the affections in group 1 are the only ones whose incidence and mortality are largely confined to age-period 40 years and over, and since the duration of life is restricted, few individuals surviving to the eightieth year and hardly any reaching the hundredth year, this means that, barring accidents, if the infectious diseases were entirely wiped out, the proportional importance of the chronic degenerative diseases would expand correspondingly. While medical and other methods of interference with the natural course of mortality may and do act in some degree at all age-periods, they can, of course, only postpone the inevitable, and this is the logical end of such activities. Considering only those activities of this character that are brought to bear

on age-group 40 years and over, it is apparent from analyses previously made that little influence in this connection can be expected from the operation of measures of public-health administration. The question resolves itself into the influence of constitutional vigor, heredity, personal hygiene, and medical and social activities. In respect of the two former categories, this material throws little light, beyond the facts that on the whole the death-rate from this group of diseases is higher in negroes than in whites and in males (except in the case of cancer of the generative organs) than in females; that the duration of life is longer in whites than in negroes; and that during the last 60 or 70 years, in association with and probably largely on account of the decline in the mortality from the nuisance-borne diseases, from the exanthemata, from tuberculosis, diphtheria, and whooping-cough among the transmissible diseases, and from diseases of early infancy, a much larger proportion of the population than was formerly the case attains and surpasses age 40.

The evidence at hand indicates, however, that when this type of natural selection—the weeding-out by these diseases in early life of a large proportion of the weak—was most effective, the members of the population who attained midlife were more vigorous of constitution. It has been shown that the mortality over the thirty-ninth year has risen rather than fallen during the last 50 years; and from a comparative study of death-rates specific for age for the various census years from 1830 to 1920, inclusive (table 136, graph 38), it appears that a reciprocal relationship obtained between the force of mortality in early and in late life. That is, in those periods of the city's history when the toll of mortality was particularly heavy during the first 4 or 5 decades of life, its rate was commonly relatively low in later life, and conversely, when for the reasons above mentioned, mortality became comparatively low in early life, the death-rate in the upper age-groups ascended to higher levels. The first condition was typical of the earlier decennia of the nineteenth century and the second characterized the last few decennia of that century and the first two of the twentieth. In the early period those few who survived the snares and pitfalls of early life were relatively tough and better withstood the vicissitudes of midlife and old age. This phenomenon is in agreement with the findings of Pearson (68), of Macdonald (69), and of Pearl (70) in comparative studies of life-tables of ancient and modern populations, although, as is to be expected, in view of the shorter interval of time involved in the present instance, these differences are less marked than in the case of the comparisons of the duration of life in the respective populations studied by these authors. It is evident, therefore, that during the last 50 years, in consequence of decline in the forces of mortality in early life, a gradually increasing ratio of the population has attained midlife, and that on the whole these individuals have proved to be poorer risks and less capable of survival to old age than were the proportionally smaller numbers who reached age 40 when natural selection was more searching in its action.

To what degree personal hygiene and changed conditions of living have affected the incidence and mortality of the diseases of this group it is impossible to reckon. On the whole, no large groups of people have ever lived in such conditions of comfort, protection from the cold, and had food and clothing in such abundance, variety, and quality as the inhabitants of modern American

cities during the last 40 or 50 years; and in Baltimore conditions of this kind have been particularly favorable.

In respect of the influence of medical activities, it is evident that modern surgery has resulted in the prolongation of the lives of many individuals who would otherwise have died of cancer and other tumors, of diseases of the biliary and urinary passages, of prostatic hypertrophy, of ulcers of the stomach and duodenum, of hernia and of intestinal obstruction, of acute infections, and of various accidents. In the same manner, whatever improvements in medical care and treatment that have taken place have acted in similar fashion in disturbing the proportional distribution of mortality among the various members of this group. It is evident, therefore, that any and all causes which have been effective in prolonging life into mid-age have increased the chances of death from the chronic degenerative diseases.

Since in comparison with those of the cardio-vascular-renal system chronic degenerative diseases of all other organs are of minor importance, disease of that system must be regarded as the normal gateway from life to death in old age. During the past 50 years they have grown decidedly in importance as the cause of natural death. The other members of this group, cancer and other tumors included, have apparently not gained in mortality, but owing partly to natural causes and partly to artificial interference, have become relatively of less importance in this respect.

At this point a very pertinent question arises. Why is it that the large and small organs (the kidneys excepted) of both internal and external secretion and the ducts of some of them, together with the skin, the brain, the locomotor apparatus, and the sex organs, are, in comparison with the cardio-vascular-renal so rarely the seat of chronic degenerative processes incompatible with continued life? A partial explanation lies in the fact that the former are more commonly the seat of benign and malignant tumors which, in the classification of mortality arbitrarily adopted here, are withdrawn from both categories. This circumstance confers an artificial advantage upon the cardio-vascular-renal system. However, when full allowance is made for this, the proportional distribution of mortality is still heavily against the latter system. Omitting from consideration for the moment the influence of sex, in proportion to their liability to give origin to fatal cancer after age 40, the organs of the body, arranged according to the embryological derivation of their most highly differentiated or characteristic cells, rank in the following order of frequency: endoderm, ectoderm, mesoderm. The cardio-vascular-renal system shares with other structures of mesodermal origin in a relative immunity to cancer. It is from the cells of endodermic origin in the highly differentiated glandular organs that cancer most frequently springs. Next in frequency stand cancers arising from the skin and other organs whose most characteristic cells are of ectodermal origin. The relatively higher mortality from benign and malignant tumors in the female is due very largely to a peculiar liability of this sex to such growths of two organs of mesodermal origin, i. e., the uterus and ovaries, and of the ectodermal tissues of the cervic uteri and of the breast. The higher mortality of the female from cancer of the latter organ is to a considerable degree offset by the greater proneness of the male to develop cancer from the other ectodermic structures, such as the skin, the lips, and the buccal mucosa.

For the rest, the comparatively greater vulnerability of the cardio-vascular-renal system in those who survive the fortieth year must depend upon attributes associated with structure, function, and extent of surface. Considering these factors in inverse order, it is apparent that, taking into account the heart, arteries, capillaries, veins, and the parenchyma of the kidneys, in surface, the cardio-vascular-renal system must exceed the various visceral organs most subject to chronic degenerative lesions other than cancer. In bulk, also, the comparison is probably in favor of the cardio-vascular-renal system. In both design and in function this system has the disadvantages as well as the advantages of a highly coordinated mechanical apparatus. During life the heart in its capacity as a force and suction pump never ceases in its alternate phases of rhythmical contraction and relaxation, by which it keeps in circulation, under considerable though varying pressure through the arteries, capillaries, and veins of a double system, a viscid fluid, heavily laden with cells. The vascular portion of the circulatory system and the kidneys work without cessation.

The lining cells of the heart and vessels and the renal epithelial cells are delicately organized and highly differentiated for a variety of functions, and are submitted to the action of numerous and varied poisons. The valve segments of the heart are delicately thin and but poorly vascularized. The rings of the four cardiac orifices are but inadequately braced to withstand the great pressures to which they are often subjected. The muscle-cells are highly differentiated, and the mechanism through which the coordination of their rythmical contractions is controlled is delicate and one easily disarranged by the stretching of the vascular rings and by other lesions. Through the medium of the vagus nerve the rate of the heart-beats is subject to interferences by stimuli from the central nervous system and from conditions acting upon the nerve itself. The elastic tissue of the intima and the fibro-elastic-muscular media of the arteries frequently give way to constant and abnormally high pressures and are susceptible to the action of a number of injurious agents. Of all the glandular organs of external secretion, the kidneys are the largest and the most highly differentiated. Far removed from the heart, they are interpolated on the vascular system as excretory organs, through which passes in a given time a large quantity of blood over an extensive and complicated vascular area. In the kidneys, as in the case of the heart and the brain, intercommunication among the smaller branches of the main arterial branches is not so free as in other important organs. In consequence, lesions of the arteries of these important organs, such as dilatations, narrowings, obliterations, ruptures, and the like, which are not infrequent, are fraught with more serious results than in other organs.

Though capable of considerable reparation after overwork and other injury and of varieties and degrees of adaptation and compensation under mechanical stresses, and in the face of serious lesions that are little short of marvelous, in proportion to the burdens it is called upon to bear the cardio-vascular-renal system of the average individual can not be classed as designed to withstand for an indefinite time the strain and stress it is called upon to bear in normal life. Whatever the history in respect to previous disease and abuses, it is uncommon to find at autopsy on an individual of 40 or 50 years of age and

dead of any cause, even accident, perfectly normal arteries, heart, and kidneys. Above age 60, whatever the history of the individual and the cause of death, extensive changes in the kidneys, arterial system, and heart are to be expected; and in the aged, widespread and grave lesions of these organs are nearly always present. Indeed, these changes are as characteristic of old age as is wrinkling of the skin.

That the changes of arterio-sclerosis are in part due to wear and tear in keeping up the blood-pressure throughout life is exemplified by the fact that, whatever the age of the individual or his history of previous diseases and excesses, sclerotic changes of the type occurring in advanced arterio-sclerosis are very rarely found in the venous system in which the blood-pressure is normally low. When, under very exceptional circumstances, venous sclerosis does occur, it is commonly localized in some one vein and evidently the result of some particular injury. While a number of different degenerative lesions have been observed in developing arterio-sclerosis and the reactions of repair and compensation on the part of the arteries, the kidneys, and the heart and the mechanism of the circulation through all stages of the process are fairly well understood, pathological anatomists are not in agreement in the interpretation of the sequences and interrelations of the various degenerative and reparative processes of the common non-syphilitic arterio-sclerosis.

In regard to causation, except that the slowly developing senile type is part and parcel of senesence, and that there is a relatively rare but quite characteristic syphilitic type, accurate knowledge is lacking. Certain it is, however, that very occasionally in the relatively young and very commonly in persons, both male and female, between 40 and 55 years of age, a very definite type of illness begins with high blood-pressure and ends usually in a few months or years with the clinical signs and anatomical lesions of arterio-sclerosis and nephritis and often of the cardiac valves and of the myocardium. In another class of cases disease begins as a primary nephritis and often ends in death with or without extensive vascular and cardiac lesions. In the typical senile form, when not complicated with some acute infection, death commonly follows apoplexy, renal or cardiac insufficiency, or an attack of angina pectoris. These and other accidents involving the cardio-vascular-renal apparatus occur in all types of the disease. One of the most characteristic concomitants of general arterio-sclerosis, especially in individuals between the fortieth and sixtieth years of life, is the enormous cardiac hypertrophy which is due to the increased work demanded of the heart to carry on the circulation under the new conditions of pressure which are determined in part at least by the arterial changes.

Finally to be considered are the cases of true endocarditis, usually of the valves, and which is commonly secondary to some acute infection. It is obvious that in fatal cases of cardio-vascular-renal disease physicians ascribe death to the lesion which is or seems to be the more prominent at the terminal stage, and hence the variety of terms used in medical nosology to cover these protean lesions. To a great degree the use of particular terms, such as fatty heart, heart failure, heart hypertrophy, decompensation, hypertension, and the like, are determined by transitory fashions. So it is clear that, by design, structure, and the nature of its function, the cardio-vascular-renal system

is unsuited to stand indefinitely the strains, stresses, and accidents to which it is subjected, its very extent in surface constitutes a mass of tissue far greater in dimension than any other viscus, the character of its lesions cause great impairment of its functions, and the accidents to which it is subject are often necessarily fatal.

Attention has been directed to the fact that certain infectious diseases, notably pneumonia, both lobar and broncho, tuberculosis, influenza, and the pyogenic infections, display rising mortality-rates after age 40, and it is well established that all of these affections are particularly common in the terminal stages of the chronic visceral diseases, and particularly of those of the cardio-vascular-renal system. This association does not, however, prove that these chronic organic diseases *per se* always determine incidence and fatality, for at least two other possible causes of lack in resistance with advancing age must be considered—decrease in organ immunity and in the general immunity provided by the usual mechanisms, whatever they may be.

That loss of organ immunity plays a large part here is evident when consideration is given to the fact that the various organs are affected in great disproportion, i. e., the lungs, the skin, and the genito-urinary system, especially in the male, very commonly, while the liver, pancreas, stomach and intestines, the central nervous system, and above all the cardio-vascular-renal system, in comparison preserve in very high degree their normal organ immunity to these processes. With advancing age the skin and the pulmonary system return in respect of weak resistance to attack and lethal force by the pyogenic cocci and the causal agent of pneumonia to the status that obtains in infancy. The asthenic character of the inflammatory reactions to local infections in old age, and the frequency with which the latter are attended by general bacteriamias, often accompanied by multiple foci of inflammation, indicate that in this period of life there occurs a deficiency in the various defensive agents supplied by the body to the blood and lymph.

The high correlation between the lethal force of influenza and of cardio-vascular-renal disease (heart disease) pointed out by Bertillon (64) and by Pearl (65) and the high correlation between old age and the fatality of pneumonia, long recognized, are indicative perhaps of the same thing, namely, lowered resistance due to changes incident to advanced age, heart disease in the correlation with influenza really standing for old age. In the discussion of influenza it was pointed out that a large proportion of the fatal cases of this disease are complicated with pneumonia, and that under the rules those with broncho-puneumonia are classified under influenza and those with lobar-pneumonia are ascribed to the latter rubric. Doubtless many individuals in the upper decades of life who are credited with dying of pulmonary tuberculosis actually die of cardio-vascular-renal disease natural to old age and *with* the lesions of chronic tuberculosis developed earlier in life, and in itself consistent with continued life.

The sexual cycle has apparently nothing to do with longevity as determined by chronic organic disease for woman, whose sexual life-period, as tested by capacity to reproduce, is much shorter than that of man, preserves after mid-life her initial superior life expectancy, and exhibits in old age no higher death-rates than man from the chronic organic diseases (cancer of the generative organs excepted) and a lower mortality from pneumonia.

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